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PROVINCE OF KWAZULU-NATAL

PROJECT: DEVELOP A UNIVERSAL ACCESS PLAN ACROSS FIVE DISTRICT MUNICIPALITIES IN KZN

FOCUS
A Division of the Crowie Property Group

[REPORT: DEVELOPMENT OF UNIVERSAL ACCESS PLAN FOR WATER SERVICES FOR UTHUKELA DISTRICT MUNICIPALITY]

REPORT TITLE	Development of Universal Access Plan for Water Services in Uthukela District Municipality
CLIENT	Department of Cooperative Governance and Traditional Affairs
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DESCRIPTION	**REVISION**	**DATE**
Uthukela District Municipality Universal Access Plan	Final	03/10/2014

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GLOSSARY

COGTA	-	Department of Cooperative Governance and Traditional Affairs
DM	-	District Municipality
DRDLR	-	The Department of Rural Development and Land Reform
DWA	-	Department of Water Affairs
GIS	-	Geographical Information System
IDP	-	Integrated Development Plan
LM	-	Local Municipality
PMU	-	Project Management Unit
RWSS	-	Regional Water Supply Scheme
TA	-	Traditional Authorities
TOR	-	Terms of reference
UAP	-	Universal Access Plan
UTDM	-	Uthukela District Municipality
WARMS	-	Water Authorisation and Registration Management System
WSA	-	Water Service Authority
WSDP	-	Water Services Development Plan
WSP	-	Water Service Provider
WTW	-	Water Treatment Works
WWTW	-	Waste Water Treatment Works
WUA	-	Water User Association

1. EXECUTIVE SUMMARY

The consortium consisting of Focus, Mott Macdonald PDNA,MHP GeoSpace and Sivuno Consulting were appointed to undertake the Universal Access Plan (UAP) for water in five of the District Municipalities in KwaZulu- Natal. The report was to focus on the following:

- Assessment of water planning status quo.
- Identify existing water supply schemes.
- Identify already proposed future water supply schemes (at a conceptual level).
- Existing and proposed water supply and demand options.
- An updated geo database.
- Preparation of a Universal Access Plan (UAP) which entails collection of infrastructure backlog, verification of existing data from the various municipalities and formulating a plan with relevant milestones and associated costs to achieve Universal Access.

The following documents were viewed for information regarding the water planning status quo and assessment of all existing supply schemes as well as proposed future supply options for each of the Local Municipalities and the District Municipality:

Documents	**Latest Report**
Uthukela District Municipality Integrated Development Plan	2013
Okhahlamba Local Municipality Integrated Development Plan	2013
Emnambithi Local Municipality Integrated Development Plan	2013
Indaka Local Municipality Integrated Development Plan	2013
Imbabazane Local Municipality Integrated Development Plan	2013
Uthukela Water Services Development Plan	2007
Development of Water Reconciliation Strategy for all towns in the Eastern Region for Uthukela District Municipality	2011
Department of Water Affairs Priority Projects	2011

The methodology applied in the development of a Universal Access Plan for Water Services in Uthukela District Municipality was as follows:-

- MM PDNA arranged meetings with the technical staff of the Uthukela District Municipality in order to obtain GIS information and confirm the water backlog data, as well as confirm existing and proposed schemes in the Uthukela District Municipality.

- MHP GeoSpace obtained Geographic Information System (GIS) spatial information from various sources, including the Uthukela District Municipality and the Department of Water Affairs. All data has been stored in an ESRI ArcGIS 10.1 relational geodatabase, using a geographic co-ordinate system (decimal degrees). Metadata has been captured for all the data within the geodatabase. Domains or look-up tables have also been included to ensure consistency in data capture across all areas, and by all users.

- Draft water supply footprints were digitised off the latest colour aerial photography available from the Department of Rural Development and Land Reform. These were captured as polygons following settlement boundaries, and using existing water infrastructure where available. Settlement boundary datasets from the Department of Water Affairs and the Department of Rural Development and Land Reform, together with household points from Eskom (captured in 2011), were used as informants in this process. Outlying households were incorporated where possible but this was not always achievable in cases of isolated households that were located away from the more densely settled areas. In some cases these isolated households consisted of independent, privately owned farms which have their own local supply. These were excluded from the water supply footprint.

- A web mapping application was developed for the District, and served on the internet using ArcGIS Server, from the ESRI suite of GIS software products. This allowed users to view the data in their particular area, and where possible, to identify gaps in the data which could then be addressed by the project team. The engineering team had editing capabilities on this website and were able to identify and edit the attributes of any of the water supply footprints, to edit their shape if necessary, or to capture completely new water supply footprints in any area. Often these consisted of Independent farm houses with their own local supply, which were excluded from the water supply footprint.

- GIS analysis was used to calculate the high and low household numbers, as well as the high and low population counts, for each of the water supply footprints. Statistics SA were consulted on the best method in which to do this, and their census data was used to calculate the average growth rate per annum between 2001 and 2011. This data was applied to calculate the population in 2014 for each polygon. The same growth rate was applied to the number of households, which was calculated from the Eskom 2011 household point data. The table below indicates the growth rate for the Uthukela District Municipality.

Census Year	**1996**	**2001**	**2011**	**% Growth from 1996 - 2001**	**% Growth from 2001 - 2011**	**% growth pa (1996 - 2001)**	**% growth pa (2001 - 2011)**
uThukela	556 550	657 736	668 848	18.2	2.0	3.6	0.2

- The levels of service (LOS) points, supplied by the Department of Water Affairs, were mapped along with the water supply footprints. These were used to indicate which households were currently supplied with water services, and those which were not yet serviced and needed schemes to be implemented.

- The highest number of households for each water supply footprint (whether from 2011 or 2014) was used to calculate current, future and probable water demand requirements, measured in million m^3 per annum.

- Map series at a scale of 1:20 000 were printed of the entire District Municipality, and these were given to MM PDNA so that conceptual water supply schemes could be designed. These designs were then returned to the GIS team, and captured into the geodatabase.

- Once the concept plans had been captured, they were checked for connectivity between adjacent municipalities. Attribute data, where available, was added to the geodatabase.

- Ownership information was added to each footprint polygon, using cadastral from the Surveyor-General and ownership data from the Deeds office. As the polygons did not follow cadastral boundaries, but rather the actual settlement points, the centroid of each footprint was used to determine the ownership of the property at that location. Ownership was divided into private, non-private (which included national, provincial and local municipal ownership) and land owned by the Ingonyama Trust Board.

- Each water demand footprint was checked against existing water infrastructure data to determine whether there was, or was not, short term water supply in the area.

LOCAL MUNICIPALITY	NO OF WATER SUPPLY FOOTPRINTS	NO OF AREAS WITH SHORT TERM SUPPLY
Okhahlamba	493	184
Emnambithi/Ladysmith	216	109
Indaka	258	133
Umtshezi	242	70
Imbabazane	103	68
Uthukela	1312	564

- MM PDNA undertook the conceptual design based on the water supply footprints provided by MHP GeoSpace. Where possible the concept designs were tied into the UTDM's planned network to avoid any duplication of infrastructure and to reduce costs.

  The following assumptions were made in undertaking the conceptual designs for the un-serviced population:

  - Water consumptions were based in accordance to the table below:

Description of consumer category	Household Annual Income range	Per capita cons (l/c/d)		
		Min	Ave.	Max.
Very High Income; villas, large detached house, large luxury flats	>R1 228 000	320	410	500
Upper middle income: detached houses, large flats	153 601 – 1 228 000	240	295	350
Average Middle Income: 2 - 3 bedroom houses or flats with 1 or 2 WC, kitchen, and one bathroom, shower	38 401 – 153 600	180	228	275
Low middle Income: Small houses or flats with WC, one kitchen, one bathroom	9 601– 38 400	120	170	220
Low income: flatlets, bedsits with kitchen & bathroom, informal household	1- 9600	60	100	140
No income & informal supplies with yard connections		60	70	100
Informal with no formal connection		30	70	70
Informal below 25 l/c/d		0	70	70

- Each household has an average of 6 people
- Some of the existing boreholes are functional.
- The existing water reticulation schemes are operational.
- Some of the existing water reticulation schemes have spare capacity.
- Existing water treatment works have the potential to be upgraded or rehabilitated.
- Schemes have some form of power supply.
- General pipe size range is from 25 mm to 150 mm diameter.
- Peak factor - 1.5
- Water losses were considered to be 35%
- Where there is an existing bulk line, connections to the bulk were kept to a minimum
- Reticulation mains were placed in the road reserve for maintenance purposes.
- District and provincial road crossings were kept to a minimum

➢ In viewing the water supply footprints on the GIS mapping the following parameters were used by MM PDNA to determine the type of scheme applicable to the different water supply footprints. The following scheme types were considered in the conceptual designs:

➢ Tie into existing schemes
➢ Existing boreholes and standpipes that are non-functional to be rehabilitated.
➢ Existing boreholes with reticulation to be rehabilitated.
➢ Boreholes mechanically operated for settlements with a low population.
➢ Boreholes electronically operated for settlements with a high population.
➢ Package Plants for settlements which are densely populated.
➢ From existing scheme pumped to new reservoir and reticulated.

Schematics and a detailed description of the various scheme types indicated above are indicated later in this document.

➢ The conceptual designs were quantified according to scheme types and the rates for various components of the water reticulation were provided by Umgeni Water and are stated in the document.

The conceptual designs and cost estimates for each of the local municipalities as well as the district municipality and based on the various schemes are summarized in the following tables. The detailed costs for each scheme type are indicated in section 8.5 of this document.

Okhahlamba LM	
Scheme Type	**Total**
Link to Existing Scheme	R 540 438 337
Small Package Plants	R 219 327 390
Exisiting boreholes electronically operated with Storage	R 64 837 505
New boreholes mechanically operated	R 17 643 780
New boreholes electronically operated	R 270 701 331
TOTAL	**R 1 112 948 343**

Ladysmith / Emnambithi LM	
Scheme Type	**Total**
Link to Existing Scheme	R 1 105 729 245
New boreholes electronically operated	R 142 064 754
TOTAL	**R 1 247 793 999**

Indaka LM	
Scheme Type	**Total**
Link to Existing Scheme	R 903 113 369
New boreholes electronically operated	R 14 662 014
TOTAL	**R 917 775 383**

Umtshezi LM	
Scheme Type	**Total**
Link to Existing Scheme	R 625 769 917
Small Package Plants	R 97 471 795
Existing boreholes electronically operated	R 6 578 675
Existing boreholes electronically operated with Storage	R 14 677 902
New boreholes mechanically operated	R 5 881 260
New boreholes electronically operated	R 149 607 968
TOTAL	**R 899 987 517**

Imbabazane LM	
Scheme Type	**Total**
Link to Existing Scheme	R 585 407 208
New boreholes electronically operated	R 15 786 415
TOTAL	**R 601 193 623**

The following table is a summary of all the local municipalities in the uThukela District Municipality for the various scheme types, and illustrates the total estimated cost for the District Municipality.

uThukela DM	
Scheme Type	
Link to existing scheme	R 3 087 950 153
Link to Existing Scheme operated with Storage	R 861 607 786
Small Package Plants	R 316 799 185
Existing boreholes electronically operated	R 6 578 675
Existing boreholes electronically operated with Storage	R 79 515 407
New boreholes mechanically operated	R 23 525 040
New boreholes electronically operated	R 592 822 483
TOTAL	**R 4 968 798 729**

- The table below indicates the backlogs in the uThukela District Municipality and the cost per capita to eradicate the current backlog.

Local Municipality	Backlogs (Households)	Cost per capita
Okhahlamba	22 841	R 8 121
Ladysmith / Emnambithi	27 051	R 7 688
Indaka	22 914	R 6 676
Umtshezi	5 195	R 28 874
Imbabazane	18 112	R 5 532
uThukela	96 113	R 9 631

- The phasing of schemes is based on the proposed plans to address the water backlogs. Application for various potential funding such as MIG, PIG etc. may be undertaken for these projects. The table below indicates the phasing.

  An average cost for each scheme type was compared with the cost estimate for an individual scheme. If the scheme was less than or equal to the average it was assumed that the project could be untaken over a year. If the cost ratio was higher than the average cost, the ratio was used to determine the duration of the project. However, this is flexible depending on the nature and type of project.

Implementation Year	LM	Total Cost
2015/16	Okhahlamba	R 1 082 879 088
	Ladysmith / Emnambithi	R 427 798 709
	Indaka	R 917 775 383
	Umtshezi	R 446 788 044
	Imbabazane	R 250 450 365
		R 3 125 691 589

Implementation Year	LM	Total Cost
2016/17	Okhahlamba	R 41 038 203
	Ladysmith / Emnambithi	R 34 020 225
	Umtshezi	R 54 657 712
	Imbabazane	R 48 772 594
		R 178 488 735

Implementation Year	LM	Total Cost
2017/18	Okhahlamba	R 282 533 905
	Ladysmith / Emnambithi	R 18 228 540
	Umtshezi	R 155 156 726
		R 455 919 171

Implementation Year	LM	Total Cost
2018/19	Okhahlamba	R 481 004 219
	Ladysmith / Emnambithi	R 767 746 524
	Umtshezi	R 243 385 035
	Imbabazane	R 301 970 664
		R 1 794 106 441

- In the Uthukela District Municipality, it is estimated that the existing water backlog of 96113 households can be eradicated by 2019 at a cost of R 4 968 798 729 to develop 232 schemes.

- All GIS data, including all current infrastructure, together with proposed schemes and the costs thereof have been incorporated into a structured geodatabase, with all relevant metadata. In some cases, metadata has also been captured for individual fields within particular datasets.

2. INTRODUCTION

2.1 Background of the study

In terms of the Kwa-Zulu Natal for Province Department of Cooperative Governance and Traditional Affairs strategic priorities 2013/14 Programme 3 (Development Planning) the Department must prepare a UAP (Universal Access Plan) with a specific focus on water, sanitation and electricity as contained in the MEC's 2013/14 Vote 11 Budget Speech of the 30th of May 2013.

The intention of the UAP is to create service delivery liberated zones. A significant number of municipalities in Kwa-Zulu Natal are close to achieving universal access in key municipal infrastructure services such as water, sanitation and electricity.

Hence there is a need to formulate a plan to quantify remaining backlogs and cost thereof.

As a result, the Municipal Infrastructure Development Business Unit of the KwaZulu - Natal Province Department of COGTA required the Focus Consortium to undertake the collection of infrastructure backlog data, verify data and compile a UAP document with relevant milestones and associated costs. The resources were selected in terms of the TOR (terms of reference) from all service providers from the PMU (Project Management Unit), provided that the requirements are met.

The consortium consisting of Focus, Mott Macdonald PDNA, MHP GeoSpace and Sivuno Consulting, and were appointed to undertake the UAP for water in five of the District Municipalities in KwaZulu-Natal. The report was to focus on the following:

- Assessment of water planning status quo.
- Identify existing water supply schemes.
- Identify already proposed future water supply schemes (at a conceptual level).
- Existing and proposed water supply and demand options.
- An updated geodatabase.
- Preparation of a UAP which entails collection of infrastructure backlog, verification of existing data from the various municipalities and formulating a plan with relevant milestones and associated costs to achieve a UAP.

2.2 Uthukela District Municipality Overview

uThukela District Municipality (UTDM) is one of ten district municipalities in the Province of KwaZulu-Natal. It is located in the western boundary of Kwazulu-Natal with Free State and Amajuba District Municipality (DM) to the north, Umgungundlovu DM to the south, Umzinyathi DM to the east and Lesotho to the west. The district consists of five local municipalities: Okhahlamba (KZ 235), Emnambithi / Ladysmith (KZ 232), Indaka (KZ 233), Umtshezi (KZ 234) and Imbabazane (KZ 236). The size of uThukela district municipality is approximately 11500 km² and has a population of 668 848 people.

Figure 1 – Uthukela District Municipality Locality Map

The following are the local municipalities situated in the UTDM:

2.2.1 Okhahlamba Local Municipality (KZ 235)

Okhahlamba Local Municipality is located on the Western edge of uThukela District. Emnambithi borders it to the northeast, Umtshezi to the east, Imbabazane Local Municipality to the southeast and Lesotho to the west.

The municipality covers an area of approximately 3 543.63 km^2 and houses 14 wards. It is the largest local municipality in the district. The population of Okhahlamba is 132 068. The Traditional Authorities (TA) within the LM includes Amangwane TA and Amazizi TA.

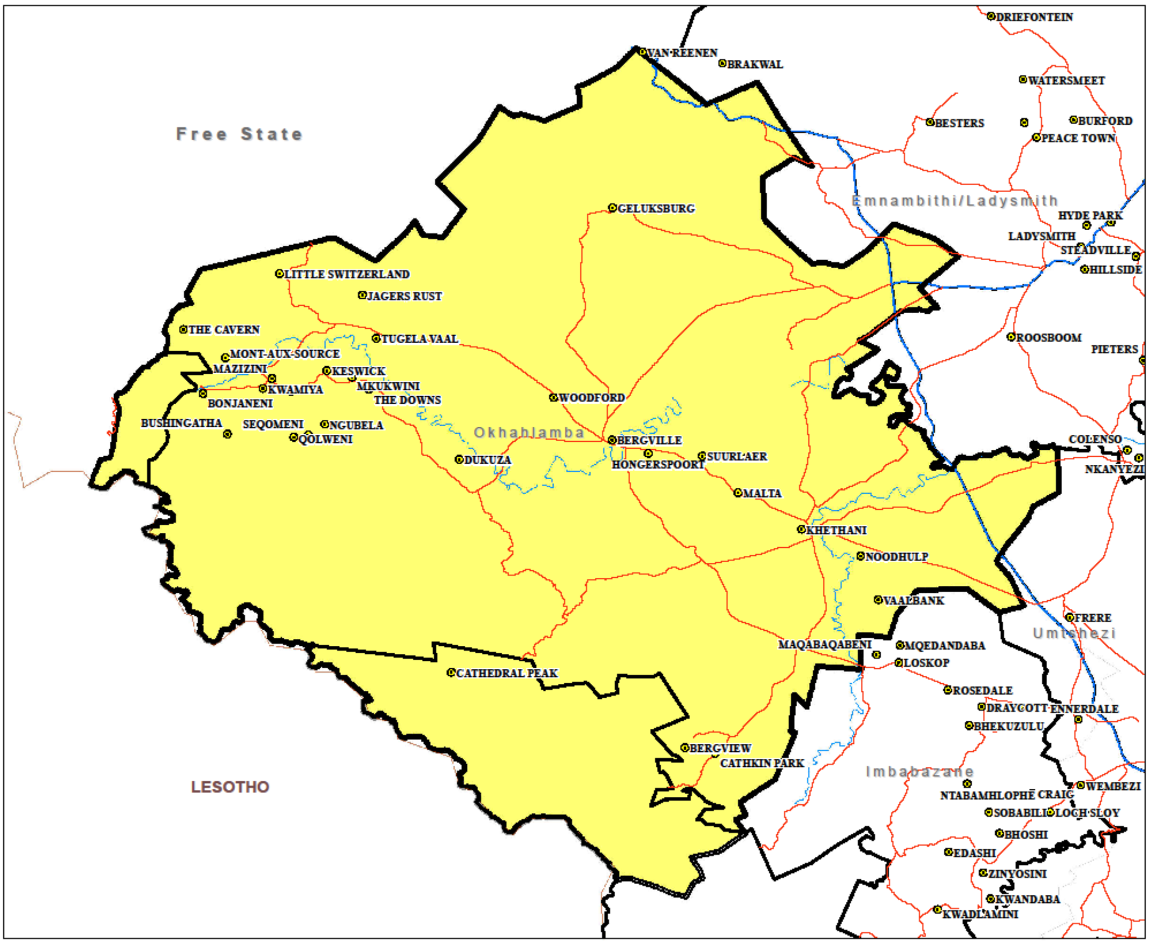


Figure 2 – Okhahlamba Local Municipality

2.2.2 Emnambithi / Ladysmith Local Municipality (KZ 232)

Emnambithi/Ladysmith Municipality (ELM) forms the northern segment of UThukela District and is bordered by the Free State province to the west, Dannhauser municipality to the north, Endumeni and Indaka municipalities to the northeast and east, Umtshezi municipality to the southeast and Okhahlamba municipality to the southwest.

It covers an area of approximately 3020km^2 in extent and has a population of about 237 437 people (Census 2011). Approximately 30% of the municipality is urban whilst 70% is rural, which presents obstacles in terms of service delivery. The TA within the LM includes Abantungwa-Kolwa TA.

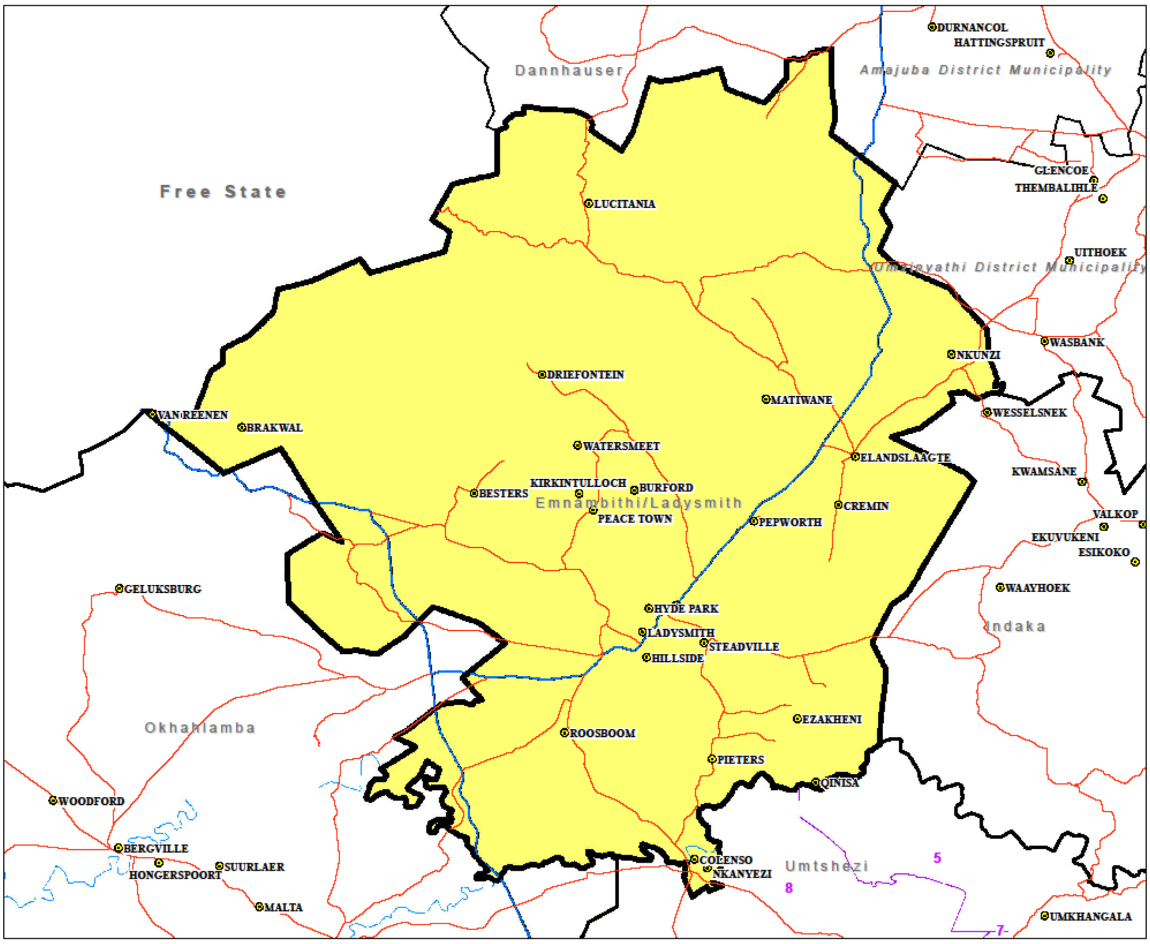


Figure 3 - Emnambithi / Ladysmith Local Municipality

2.2.3 Indaka Local Municipality (KZ 233)

The Indaka Municipality is a newly established municipality (established 18 December 2000), without a well-established economic centre. It shares borders with Emnambithi, Endumeni, Msinga and Umtshezi municipalities and is situated 49 km East of Ladysmith.

The Indaka Municipality's land area comprises of 991.71km² which is approximately 9% of the total uThukela District Municipality land area. The settlement patterns are dispersed which has resulted in under-developed land and settlement patterns. This presents a challenge in that it is expensive to deliver services. Ingwe TA, Mabaso TA, Sithole TA, Mthembu TA, Gamu TA, Nxumalo TA, Mbhense TA, Sigweje TA and Mchunu TA all fall within the Indaka LM. Indaka has dense rural villages which are mainly located in the traditional areas. The population of Indaka is 103 116 which constitutes 14% of the UTDM population.

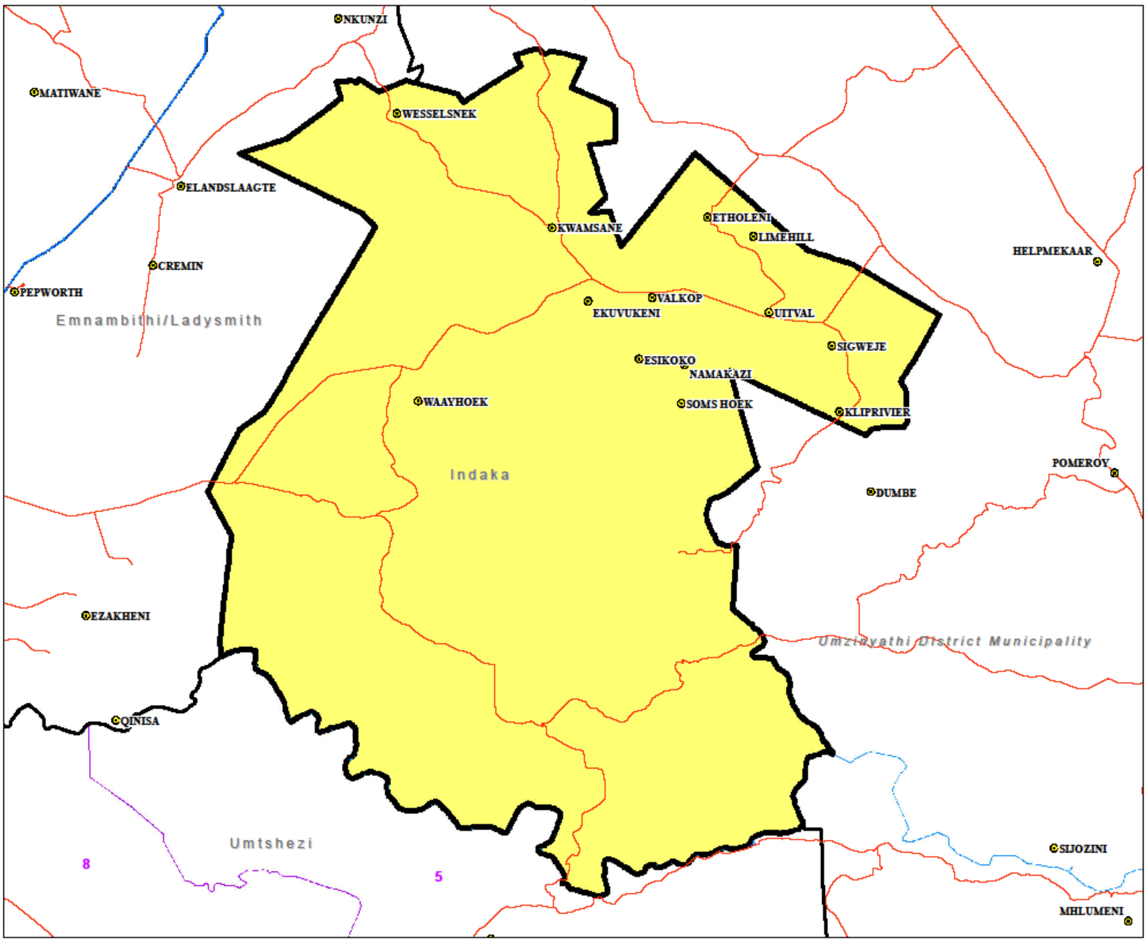


Figure 4 – Indaka Local Municipality

2.2.4 Umtshezi Local Municipality (KZ 234)

Umtshezi Local Municipality is located approximately 165km north-west of Durban and 400km south-east of Johannesburg. It covers 2130.85km². Sourced from Census 2011, the 2013/2014 IDP states that the population of Umtshezi is 83 153 which represents 12% of the UTDM population making it the smallest local municipality in UTDM. There are no TAs in the LM.

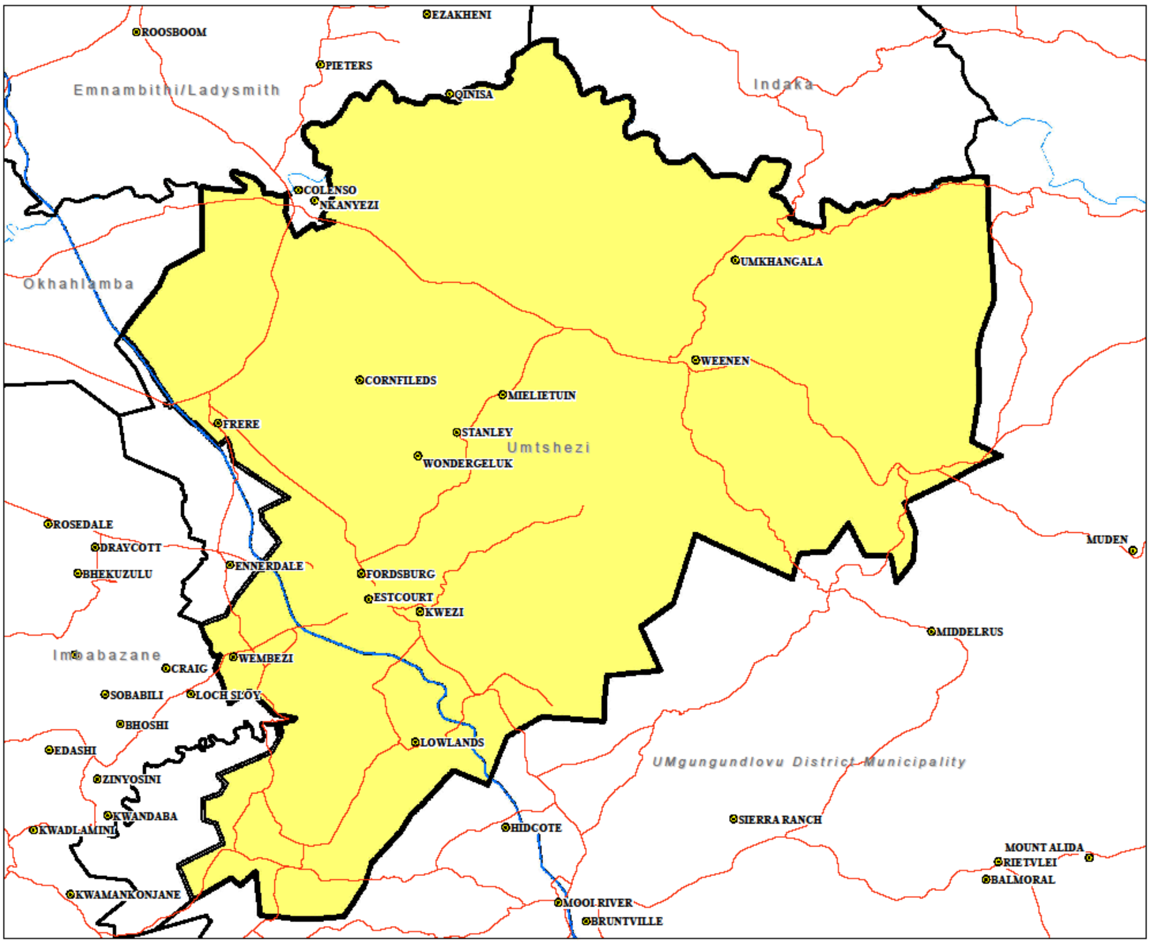


Figure 5 - Umtshezi Local Municipality

2.2.5 Imbabazane Local Municipality (KZ 236)

This Municipality covers 827.74km^2 and was established in 2000 and comprising of two areas, namely Ntabamhlophe and Loskop. It is located at the foothills of the central uKhahlamba Drakensberg Park (World Heritage Site), and is situated between uKhahlamba, Umtshezi and Mooi Mpofana Municipality.

There are six Traditional Authorities within the jurisdiction of Imbabazane namely Amangwe TA, Hlubi TA, Mabaso TA, Mhlungwini TA, Dhlamini TA and Abambo TA. The municipality has no established town and it only covers the rural areas. The population of Imbabazane is 113 073 which equates to 20% of the UTDM population.

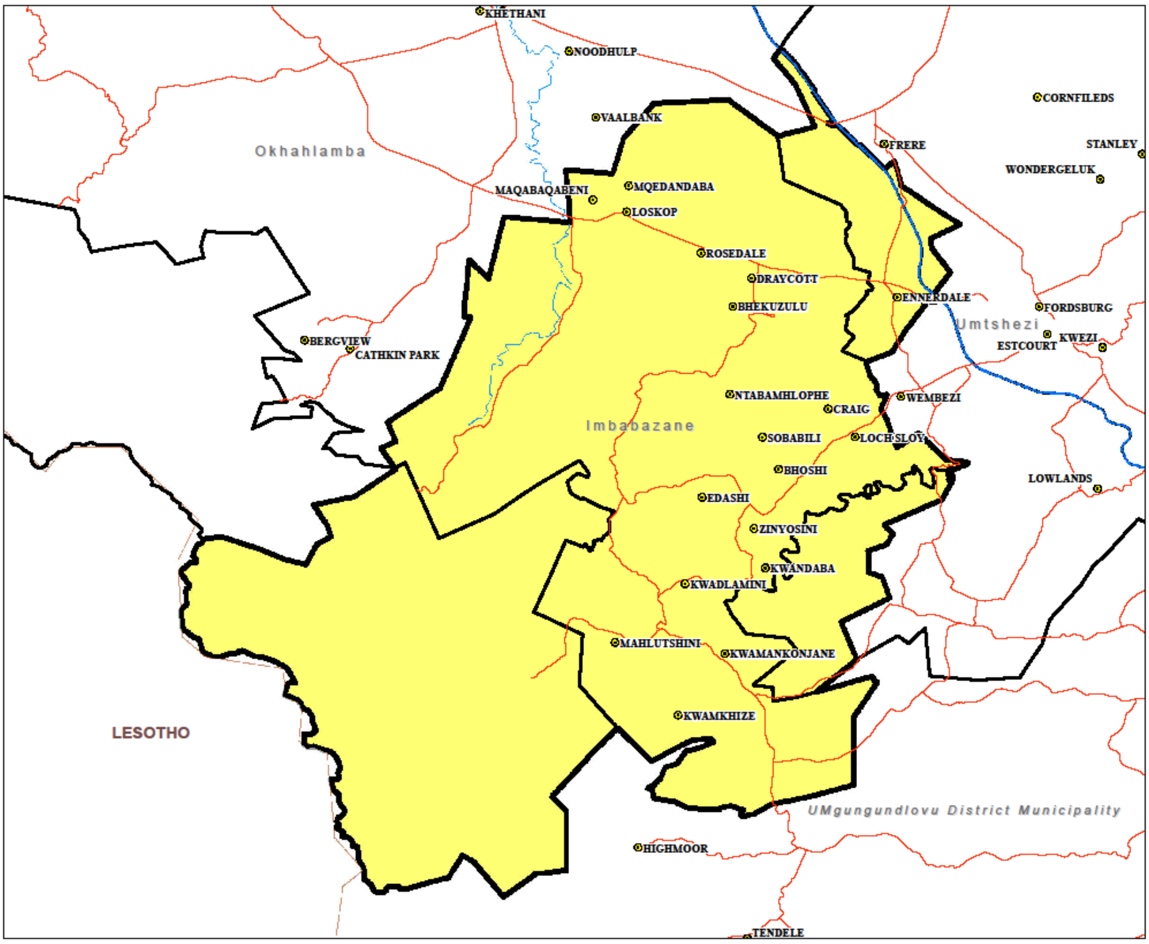


Figure 6 - Imbabazane Local Municipality

3. ASSESSMENT OF WATER PLANNING STATUS QUO

In order to assess the current water and sanitation situation in Uthukela District Municipality, data in the form of Geographic Information System (GIS) spatial information was obtained from various sources, among them the Department of Water Affairs (DWA) and Uthukela District Municipality.

All spatial data has been stored in an ESRI ArcGIS 10.1 relational geodatabase. Due to the spatial location of the five District Municipalities in which work was undertaken, all data was stored in a geographic co-ordinate system i.e. decimal degrees. Where necessary, source data has been projected to the required co-ordinate system. Metadata (information about the data – e.g. source, date, capture method) has been captured within the geodatabase.

The geodatabase also includes base data such as boundaries, roads and place names, as well as household points from the Eskom study of 2011. Domains within the geodatabase behave as look-up tables, which allow the user to update the data using specific values. This ensured consistency in data capture across all team members and across all areas in terms of the way data was captured, as well as the type of data captured.

Domains include the bulk water classification, type and condition, together with the waters scheme name and maintenance requirements. Domains can be edited and updated to allow for changes in users and projects. Once all currently available data had been collated, the district local municipality was contacted to see if there was any additional data that could be obtained and added to the database. Uthukela District Municipality provided the project team with all data that was available and this data has been incorporated into the mapping and design of the proposed schemes.

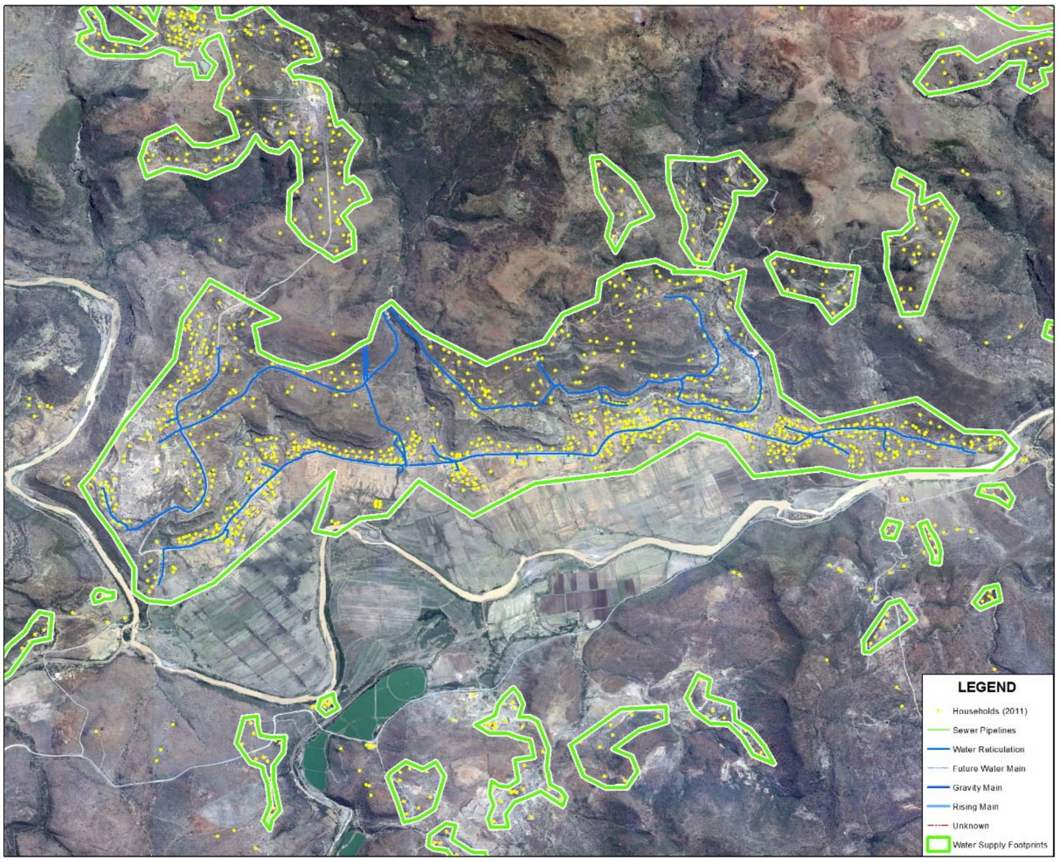
Map 1 – Example of water infrastructure in the Wembezi area

4. DEVELOP CONTINUOUS WATER SUPPLY FOOTPRINT AREAS

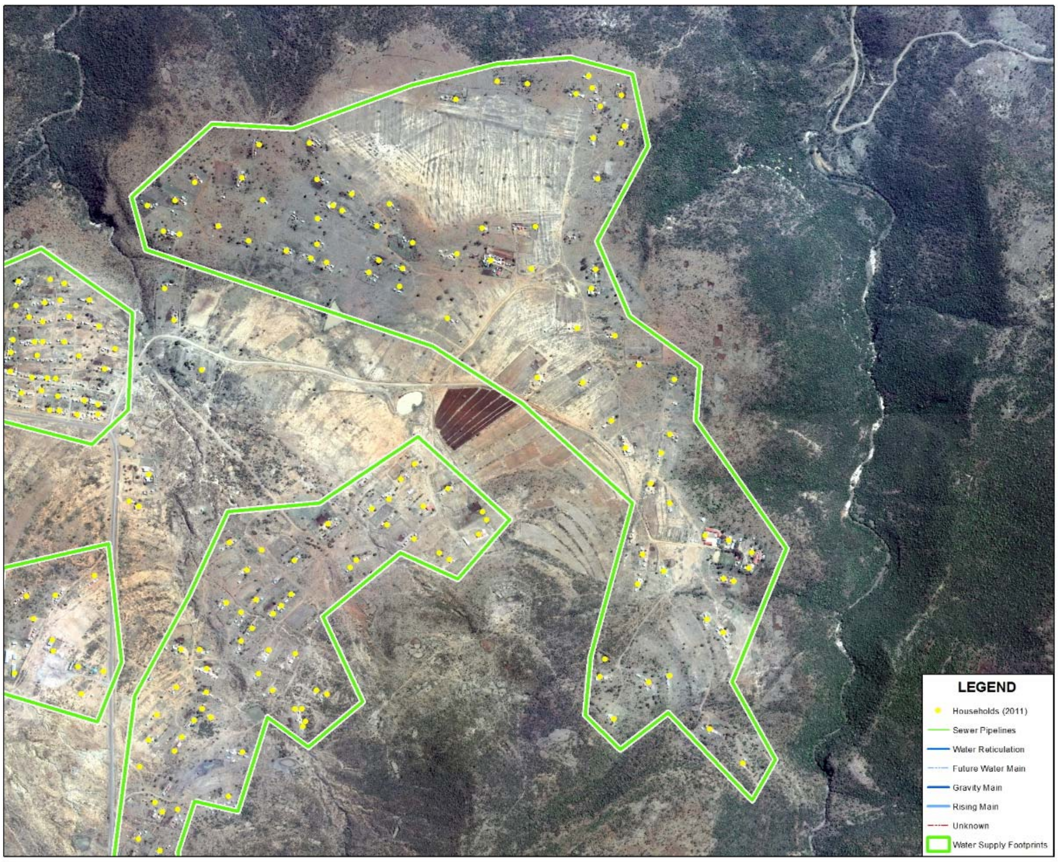
After consultation with Umgeni Water, water supply footprints in the District Municipality were captured as polygons tightly following the edge of settled areas. The data was captured on screen through heads-up digitising against the latest colour aerial photography (ranging from 2009 – 2011) available from the Department of Rural Development and Land Reform. The scale of capture was 1: 10 000, with 1: 5000 capture being done in dense areas.

Areas for capture were identified primarily using the Eskom 2011 household point data, together with additional settlement information (DWA settlements; Department of Rural Development and Land Reform settlements) and existing infrastructure data. These were overlaid onto aerial photography, and polygons were created around obvious settled areas. Outlying households were incorporated where possible but this was not always achieved in cases of isolated households that were far away from more densely settled areas. Once the above data sources had been exhausted, the whole district was panned through and any additional settlements were picked up from the aerial photography.

These water supply footprints were captured over the whole district, including areas where there was existing infrastructure and/or supply.



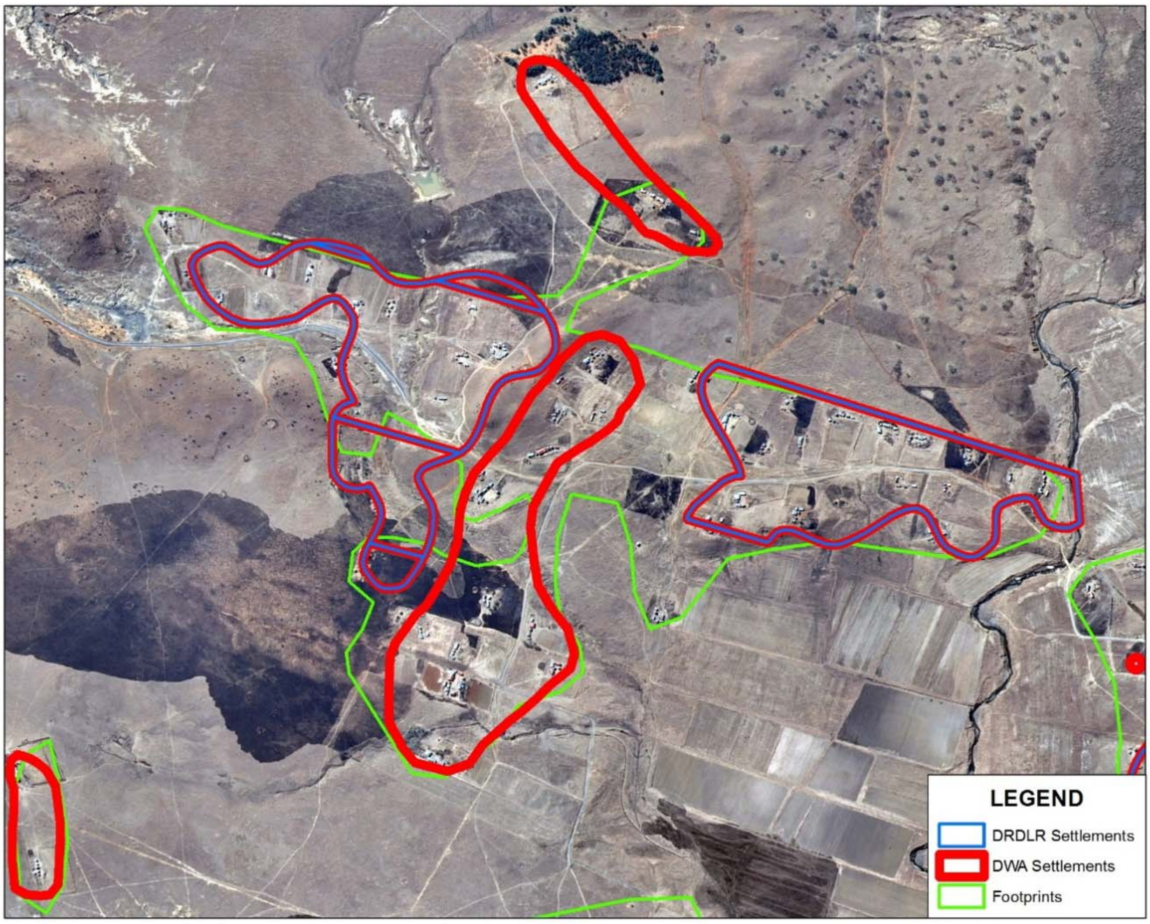
Map 2 – Water Supply Footprint with existing water reticulation



Map 3 – Water Supply Footprint where no water reticulation exists

An example of the differences between the settlement boundary datasets is illustrated in Map 4**.**

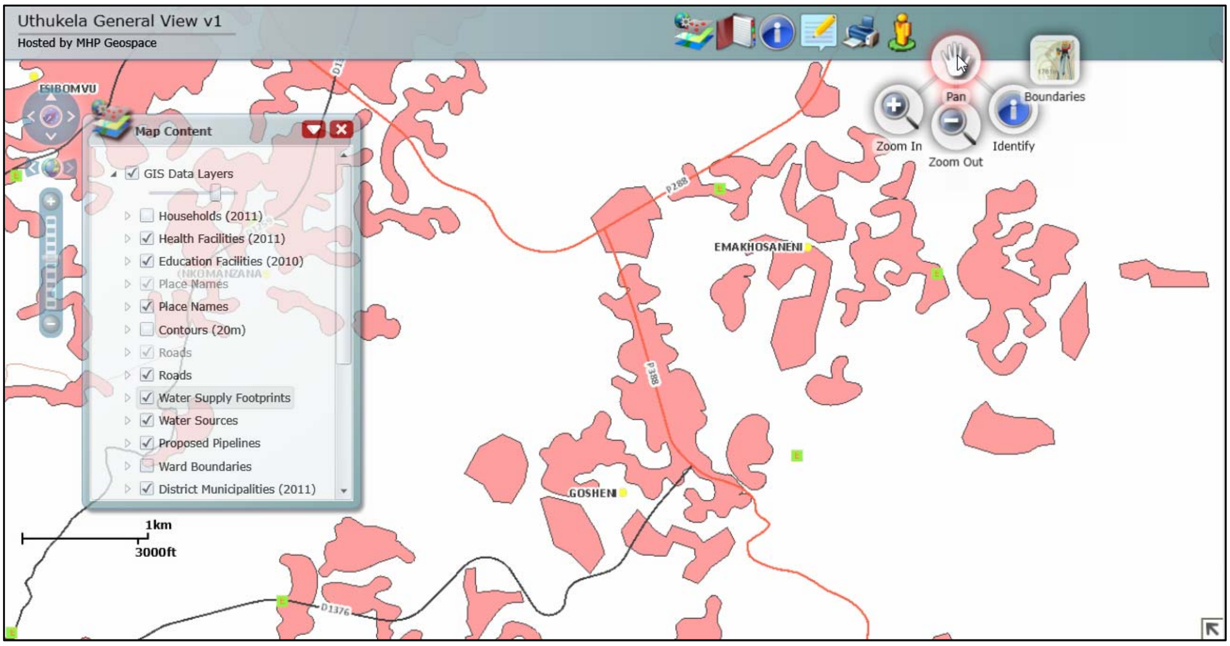
There are areas where the boundaries between the datasets are co-incident (the blue lines lie over the red lines), as well as areas where the datasets differ.



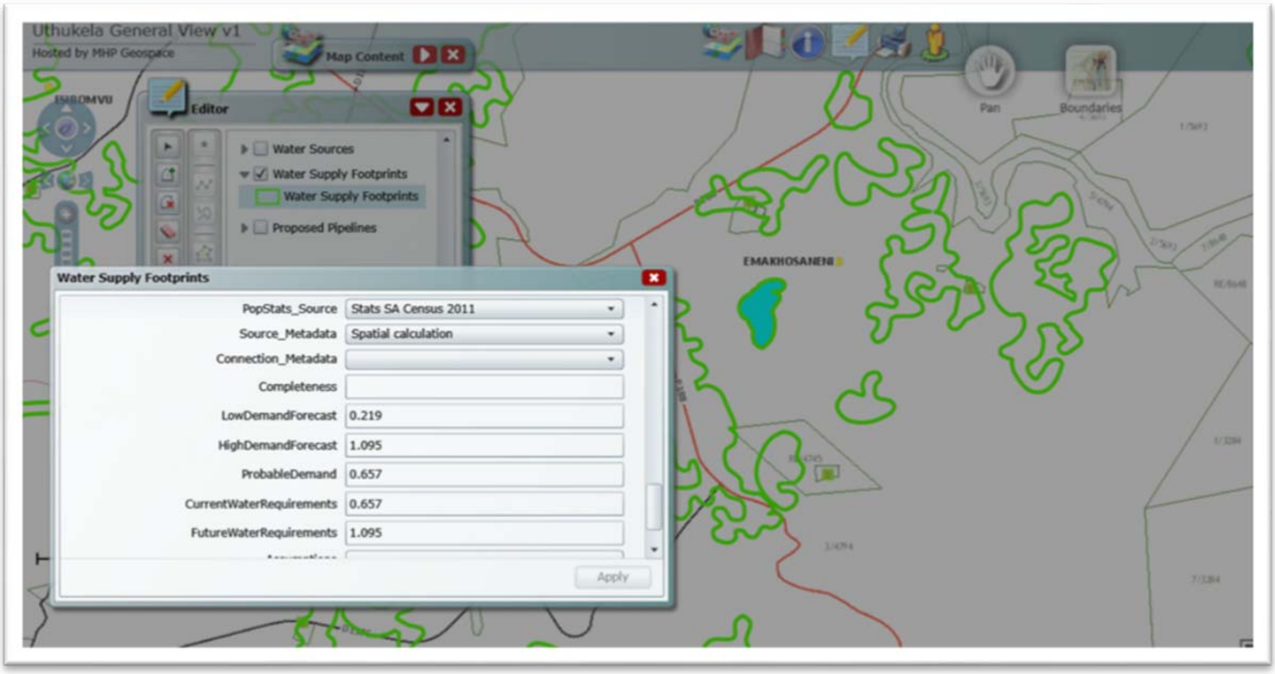
Map 4 – Example of settlement boundary datasets

Database fields were added to the attribute listing as per the attributes stipulated by Umgeni Water. A detailed list and descriptions of these fields can be found in Annexure 1.

Due to the time constraints of this project, and in an effort to make as much data as possible available to both the project team, and to the District Municipality, a web mapping applications was developed for the District, and served on the internet using ArcGIS Server, from the ESRI suite of GIS software products. This allowed users to view the data in their particular area, and where possible, to identify gaps in the data which could then be addressed by the project team. The water demand area polygons captured in the desktop study were included in this application.



Map 5 – Screenshot of the web mapping application



Map 6 – Screenshot of the editor capability on the web mapping application

The engineers from Mott Macdonald PDNA (MM PDNA) were given editing capabilities to the water demand area layer on the website. This allowed them to identify and edit the attributes of any of these areas, to edit their shape if necessary, or to capture completely new areas at any location. These online edits were written back to the base database, to be verified later in the office.

In conjunction with this data capture through the web application, visits to the District Municipality were undertaken to explain the steps of the project. A brief overview of the existing data was given, together with a short demonstration of the web mapping application, with explanation of the reasons behind this application which is primarily that of onsite data capture while working with the municipal employees.

4.1 Verification of existing information received from the UTDM

MMPDNA met with a representative from UTDM. The outcomes of this meeting are summarized below.

Date: 19/2/2014

Officials:	Clive van Niekerk	0828011858	clive@uthukeladm.co.za
	Mduduzi Radebe	079 511 5559	mdu@uthukeladm.co.za

Comments: The officials of the district municipality, Mr Van Niekerk and Mr Radebe indicated that the municipality did not have any information regarding existing schemes in the DM.

The DM did not have drawings which indicated planned reticulation. The officials could not provide any information regarding the number and extent of existing schemes.

MMPDNA were referred to the various local and district municipalities IDP's and WSDP's. They did however handover GIS information directly to MHP Geospace. Due to the municipalities lack of information we are unable to provide any level of confidence hence 0%.

Our analysis is therefore based purely on information extracted from the various IDP's and WSDP's.

5. EXISTING WATER SUPPLY SCHEMES

5.1 UTDM SERVICE POLICY

The Water Service Authority (WSA) and Water Service Provider (WSP) is the UTDM.
The UTDM's Water Services Development Plan (Revision 2006) defines the following levels of service:

5.1.1 *Water Service Levels*

Communal / basic water supply: i.e. Communal street taps (RDP standards) a minimum of 25 litres per person per day at a maximum walking distance of 200m.

Controlled volume supply: E.g. Yard Tanks. Each house is provided with a tank, which holds about 200 litres. The tank gets filled up once a day. This type of service is often referred to as an intermediate level of supply.

Uncontrolled volume supply: There are generally two types: *yard tap connection* which provides a minimum of 60 litres per person per day from a single tap within the consumer's property or water is piped into the house at to take water to taps in the kitchen, bathroom, toilet etc.

Rudimentary potable water supply: a minimum of 5 litres per person per day at a maximum walking distance of 800m and not more than 50 families per source that can be upgraded.

5.1.2 *Sanitation Service Levels*

5.1.2.1 Consumer installations: Dry

Basic sanitation: The provision of appropriate health and hygiene education and a toilet which is safe, reliable, environmentally sound, easy to keep clean, provides privacy and protection against the weather, well ventilated, keeps smells to a minimum and prevents the entry and exit of flies and other disease- carrying pests.

Ventilated Pit: A basic pit latrine structurally reinforced without preventing water seepage into surrounding soil, a slab that seals the edges of the pit and a screened air pipe that vents smells from the pit into the air above the privy.

The concrete slab over the pit is not standard requirement for all VIP toilets, but necessary under certain geotechnical conditions and it must comply with ground water protocol.

Eco San option: one of a range of sanitation options that covert the waste products into re-usable agricultural soil conditioners of fertilizers on-site (usually without water use) a ventilate improved pit (VIP) latrine per household that includes approved sub and top structures located within50m of the homestead.

5.1.2.2 Consumer installations: Wet (septic tanks)

Water is flushed into a digester where certain bacteria and other organisms breakdown the solids. Digester effluent flows into the soak away, then the ground and it must be ensured that the soak away does not cause pollution of ground water.

There can be a build-up of sludge in the digester that has to be pumped out occasionally. In some cases the effluent from the septic tank is discharged into the bulk sewer network, which leads to a sewage treatment plant or oxidation ponds.

Discharge to wastewater treatment works
Here there are generally two types: intermediate (e.g. aqua privy with solids free sewer which is similar to a septic tank, but instead of a soak away the digester effluent flows into a pipe which connects to a small sewer in the road reserve).

Full waterborne refers to the situation where a flushing toilet is used; the wastewater flows to a sewer on the site, then to sewers on the street. Effluent discharged from sewage treatment works must meet national effluent discharge quality standards in order to avoid polluting the water resources.

With regards to standards of service, each level of service will comply with the design standards in terms of the municipal water services bylaws.

5.2 Water Resources

5.2.1 Rivers

The District is well endowed with natural water resources, notably:

- Tugela River - From WR90 (1994), the incremental natural Mean Annual Runoff (MAR) of the upper Tugela River is 1 256 million m_3 (ISP, 2004). This includes the run off in the Klip River. Its total catchment area is approximately 29,100 square kilometers (11,200 sq mi).
- Klip River, a tributary of the Tugela River
- Little River Tugela, a tributary of the Tugela River - The capacity of the Little Tugela weir supplying the scheme is not known to be able to determine net yield. The natural MAR of the Little Tugela River up to Little Tugela weir (at outlet of quaternary catchment V13C) is 247.59 million m^3/a.
- Sundays River to the east, a major tributary of the Tugela River – According to the ISP, 2004, the available water in the Sundays River system is estimated to be 8 million m^3/a, after taking into account the environmental water requirements.
- Bushmans River to the south, a tributary of the Tugela River – According to the IDP, the available water in the Bushmans River catchment up to the confluence with the Tugela River is 80 million m^3/a.
- Sandspruit River, a tributary of the Tugela River
- Khombe River, a tributary of the Tugela River

5.2.2 Dams

The major water bodies in the district are:

- Spioenkop Dam - Has a storage capacity of 280 million m^3.
- Woodstock Dam - The storage capacity of Woodstock Dam being 380 million m^3/a.
- Kilburn Dam - Has a storage capacity of 36,700 m^3.
- Driel Barrage - Has a storage capacity of 8.7 million m^3.
- Wagensdrift Dam - Has a storage capacity of 55.9 million m^3.

- Oliphantskop Dam - The maximum capacity of the raw water abstraction works from the Oliphantskop Dam is provided as 5 Ml/d. The MAR of the Sundays River downstream of Oliphantskop Dam at the outlet of quaternary catchment V60C, but excluding quaternary catchment V60A where the Slangdraai Dam is located, is 90.42 million m_3/a, while the MAR at the outlet of Oliphantskop Dam was estimated to be 44.17 million m_3/a. The gross yield of Oliphantskop Dam could not be determined as its storage capacity is unknown.
- Slangdraai Dam - With a storage capacity of 10.3 million m_3/a, it has been estimated that the Slangdraai Dam has a historical gross yield of approximately 6.14 million m^3/a.
- Windsor Dam – Silted up and no longer in use.
- Quedsizi Dam – Used for flood attenuation.
- Bell Park Dam - Has a storage capacity of 7.5 million m^3. The existing Bell Park Dam has a gross yield of approximately 3.38 million m^3/a.
- Shamrock – Used for irrigation.
- Weenen Canals – Used for irrigation.
- Clifford Chambers Weir
- Khombe Weir
- Puterill Weir
- Jagersrust Dam

5.3 Existing Water Supply Schemes

In undertaking the design of new and additional reticulation for the various local municipalities the available capacities of the various treatment plants were required. With the growth in population there was a need to determine when interventions were required i.e. extension of existing water treatment works or construction of new plant to serve the new/additional demands.

According to reports outlining the reconciliation strategies for the various water schemes in the UTDM regarding the availability of water resources is outlined below.

5.3.1.1 Zwelisha Moyeni Water Supply Scheme (Okhahlamba LM)

(Source: First Stage Reconciliation Strategy for Zwelisha Moyeni Water Supply Scheme Area Okhahlamba Municipality, 2011)

The schematic layout of the Zwelisha Moyeni Water Supply Scheme is shown in Figure 7 below. The Scheme comprises of raw water abstraction from the Khombe River weir, a water treatment works on the outskirts of the village of Zwelisha and bulk service storage infrastructure and distribution networks. The scheme also comprises of a number of boreholes which are supplying the surrounding villages, which have not yet been connected to the main water supply scheme.

There are no known major water quality problems in the Zwelisha Moyeni Water Supply Scheme area. It is however likely that the quality of the Khombe and Tugela River systems is significantly affected during periods of low flow due to the land use activities upstream which causes soil erosion. The geology and the topography of the area are such that there is limited potential for significant groundwater development. Currently there is some groundwater use in the outlying areas of the Zwelisha Moyeni Water Supply Scheme area.

There are no reported water quality problems associated with the groundwater.

Water Treatment Works

The Zwelisha WTW was constructed in two phases with the first phase having a maximum design capacity of 2.0 ML/d completed in 2005 and the second phase of similar capacity completed in 2007. It is the only treatment works that supplies the scheme area, with some of the surrounding communities supplemented from boreholes. The total peak hydraulic design capacity of the water treatment works is 4.0 ML/d (WSDP, 2007). The average annual flow rate of the treatment works is estimated to be 2.67 ML/d based on a peaking factor of 1.5.

The Zwelisha WTW is a conventional treatment plant comprising of the following process components:

(i) *Flocculation channels*: The raw water is pumped from the Khombe River to the inlet works where the chemicals are added as the water flows into the flocculation channels. Polyelectrolyte dosing resulting in coagulation takes place to form the flocs.

(ii) *Clarification (sedimentation) tanks*: The flocs that have formed in the flocculation channels are then settled in the sedimentation tanks under gravity. The settled sludge is removed by frequent de-sludging of the tanks and sent to the sludge lagoons where the sludge is dried while the supernatant water is discharged back into the river. The plant was not designed for recycling of the wastewater.

(iii) *Rapid Gravity Sand Filtration*: The clarified water is then filtered through a set of rapid gravity sand filters as a final polishing before chlorination of the treated water.

(iv) *Chorine contact tank*: The filtered water is then stored in the chorine contact tanks where chlorination takes place before pumping the water to the command reservoirs in the villages for distribution.

The total raw water abstracted for treatment at the Zwelisha WTW in 2008 was estimated as 1.79 million m^3/a (4.9 ML/d) based on the estimated treated water production with 12% losses. The treated water production was provided as provided in the WSDP to be 1.58 million m^3/a (4.32 ML/d).

The current utilisation of the bulk water supply infrastructure is approximately 102% (Table 1). The existing bulk water supply infrastructure is therefore insufficient to meet the required treated water production of Zwelisha Moyeni Water Supply Scheme, including any water services backlogs.

Treatment Work Name	**Type of plant**	**Raw water source**	**Hydraulic Design capacity (ML/d)**	**Average flow rate (ML/d)**	**Treated water production (ML/d)**	**Current utilisation (% of ave. design capacity)**
Zwelisha WTW Capacity	Conventional	Khombe River	2.00	1.33	1.33	100%
Zwelisha Phase 2 WTW	Conventional	Khombe River	2.00	1.33	1.40	105%
Boreholes			1.58	1.58	1.58	100%
Total			5.58	4.25	4.32	101.5%

Table 1 - Water Treatment Works in operation in the Zwelisha Moyeni Water Supply Scheme area

(Source: First Stage Reconciliation Strategy for Zwelisha Moyeni Water Supply Scheme Area Okhahlamba Municipality, 2011)

According to the WSDP, 2007, there are operational problems at the treatment works, particularly with seasonal changes to the quality of the raw water. This is because the Zwelisha treatment works abstracts directly from the Khmobe River where there is significant soil erosion taking place upstream of the abstraction point. The works does not comply with SANS 241, 2001 for potable drinking water quality standards. It is particularly the case with the high turbidity levels that can be experienced in summer, with levels of 80 NTU.

Treated water bulk supply infrastructure
The treated water from the Zwelisha WTW is pumped from the clearwater tanks to various service reservoirs in the scheme before distribution into the scheme's reticulation network. All pumping systems have standby capacity.

Bulk Storage
The Zwelisha Moyeni Water Supply Scheme area has a total estimated reservoir storage capacity of 7.5 ML. The service storage capacity ranges from 0.25 ML steel tanks to 1.5 ML reinforced concrete (RC) service reservoir in the villages of Zwelisha and Moyeni. The service storage capacity provides for a 1.7-day or 42-hour storage based on the current gross average annual daily demand, but in summer months this reduces to approximately a 28-hour storage capacity or 1.2-day storage, based on present treated water requirements (see Table 2).

The reservoir storage capacity of Zwelisha Moyeni Scheme is therefore less than the accepted norm of 48 hours of summer peak requirement for urban areas. This norm has been determined to meet the following requirements:

- Balance the fluctuating demands from the distribution system, permitting the source to give a steady or differently phased output;
- Provide a supply during a failure or shutdown of treatment plant, pumps or bulk mains leading to the reservoir; and
- Provide a reserve of water to meet fire and other emergency demands.

Additional service storage capacity is therefore required in the near future to meet the current and future summer peak requirements.

Parameters	Bergville Water Supply Scheme area
Total Storage capacity (ML)	7.5
Storage Ratio on present annual average consumption (Hours)	42
Storage Ratio on present average peak week consumption (Hours)	28

Table 2 - Service Storage Reservoir in Zwelisha Moyeni Water Supply Scheme area
(Source: First Stage Reconciliation Strategy for Zwelisha Moyeni Water Supply Scheme Area Okhahlamba Municipality, 2011)

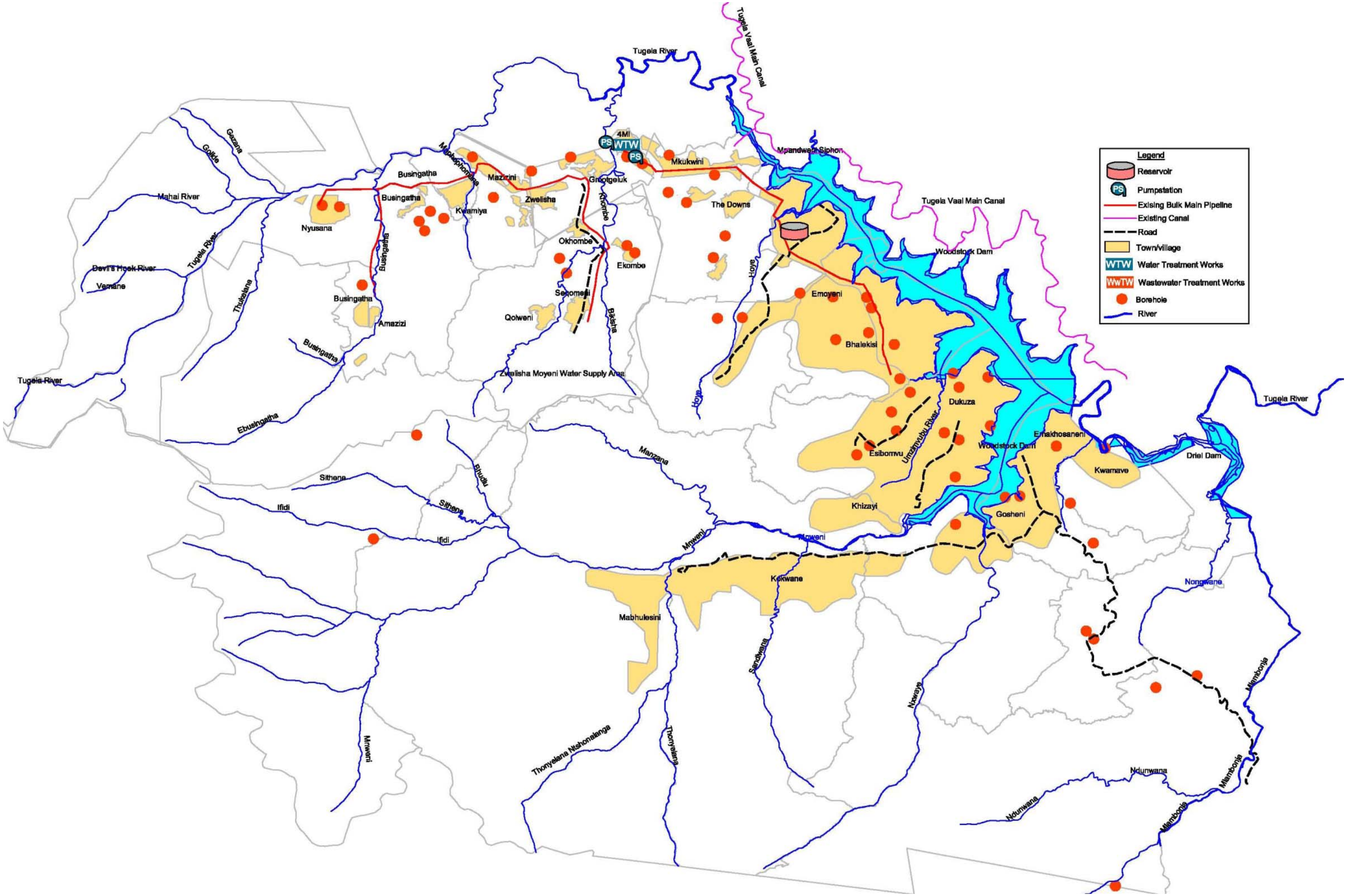


Figure 7 - Schematic layout of Zwelisha Moyeni Water Supply Scheme

(Source: First Stage Reconciliation Strategy for Zwelisha Moyeni Water Supply Scheme Area Okhahlamba Municipality, 2011)

5.3.1.2 Bergville Water Supply Scheme (Okhahlamba LM)

(Source: First Stage Reconciliation Strategy for Bergville Water Supply Scheme Area Okhahlamba Municipality, 2011)

The Bergville Water Supply schematic layout of the infrastructure for residential and non-residential consumption in the area is shown in Figure 8.

There are no known major water quality problems in the Bergville Water Supply Scheme area. It is likely that the quality of the Tugela River is, significantly affected during periods of low flow, due to the upstream land use activities and soil erosion. The geology and the topography of the area are such that there is limited potential for significant groundwater development. Currently there is some groundwater use in the outlying areas of the Bergville Water Supply Scheme area.

There is no reported water quality problems associated with the groundwater

The Bergville Water Supply Scheme comprises of raw water abstraction in the Tugela River from Driel Barrage, a water treatment works on the outskirts of the town and bulk service storage infrastructure and distribution networks.

Water Treatment Works

The Bergville WTW is the only treatment works that supplies the town with some of the surrounding communities supplemented from boreholes. The peak hydraulic design capacity of the water treatment works is only 2.88 ML/d (WSDP, 2007). The average annual flow rate of the treatment works is estimated to be 1.92 ML/d based on a peaking factor of 1.5.

The Bergville WTW is a conventional treatment plant comprising of the following process components:

(i) *Flocculation channels*: The raw water is pumped from the Tugela River to the inlet works where the chemicals are added as the water flows into the flocculation channels. Coagulation by polyelectrolyte dosing takes place to form the flocs;

(ii) *Clarification (sedimentation) tanks*: The flocs that have formed in the flocculation channels are then settled in the sedimentation tanks under gravity. The settled sludge is removed by frequent de-sludging of the tanks and sent to the sludge lagoons where the sludge is dried while the supernatant water is discharged back into the river. The plant was not designed for recycling of the wastewater.

(iii) *Rapid Gravity Sand Filtration*: The clarified water is then filtered through a set of rapid gravity sand filters as a final polishing before chlorination of the treated water.

(iv) *Chorine contact tank*: The filtered water is then stored in the chorine contact tanks where chlorination takes place before pumping the water to the command reservoirs in Bergville town for distribution.

The total raw water abstracted for treatment at the Bergville WTW in 2008 was estimated as 1.53 million m^3/a (4.19 ML/d) based on the estimated treated water production with 12% losses. The treated water production was provided as provided in the WSDP to be 1.35 million m^3/a (3.69 ML/d).

As illustrated in Table 3 below, the current utilisation of the bulk water supply infrastructure is approximately 148%. The existing bulk water supply infrastructure is therefore only sufficient to meet the required treated water production of Bergville Water Supply Scheme until at least 2013.

Treatment Work Name	**Type of plant**	**Raw water source**	**Hydraulic Design capacity (ML/d)**	**Average flow rate (ML/d)**	**Treated water production (ML/d)**	**Current utilisation (% of average design capacity)**
Bergville WTW	Conventional	Tugela River, Driel barrage	2.88	1.92	3.11	162%
Boreholes			0.58	0.58	0.58	100%
Total			3.46	2.50	3.69	147.8%

Table 3 - Water Treatment Works in operation in the Bergville Water Supply Scheme area (Source: First Stage Reconciliation Strategy for Bergville Water Supply Scheme Area Okhahlamba Municipality, 2011)

According to the WSDP, 2007, there are operational problems at the treatment works particularly with seasonal changes to the quality of the raw water, as the Bergville treatment works abstracts directly from the Tugela River, with significant soil erosion taking place upstream of the abstraction point. The works does not comply with SANS 241, 2001 for potable drinking water quality standards, particularly in the case of turbidity levels which is in the range of 80 NTU, experienced in summer.

No information is available on the condition and performance of the water treatment works infrastructure.

Treated water bulk supply infrastructure

The treated water from the Bergville WTW is pumped from the clearwater tanks to various service reservoirs in the scheme before distribution into the scheme's reticulation network. All pumping systems have standby capacity.

Bulk Storage

The Bergville Water Supply Scheme area has a total estimated reservoir storage capacity of 10 ML which supplies the scheme area. The service storage capacity ranges from 0.25 ML steel tanks to 10 ML reinforced concrete (RC) service reservoir in the town of Bergville.

The service storage capacity provides for a 2.7-day or 65-hour storage based on the current gross average annual daily demand, but in summer months this reduces to approximately a 43-hour storage capacity or 1.8-day storage, based on present treated water requirements (see Table 4).

The reservoir storage capacity of Bergville is therefore less than the accepted norm of 48 hours of summer peak requirement for urban areas. This norm has been determined to meet the following requirements:

- Balance the fluctuating demands from the distribution system, permitting the source to give a steady or differently phased output;
- Provide a supply during a failure or shutdown of treatment plant, pumps or bulk mains leading to the reservoir; and
- Provide a reserve of water to meet fire and other emergency demands.

Additional service storage capacity is therefore not

Parameters	Bergville Water Supply Scheme area
Total Storage capacity (ML)	10
Storage Ratio on present annual average consumption (Hours)	65
Storage Ratio on present average peak week consumption (Hours)	43

Table 4 - Service Storage Reservoir in Bergville Water Supply Scheme area

(Source: First Stage Reconciliation Strategy for Bergville Water Supply Scheme Area Okhahlamba Municipality, 2011)

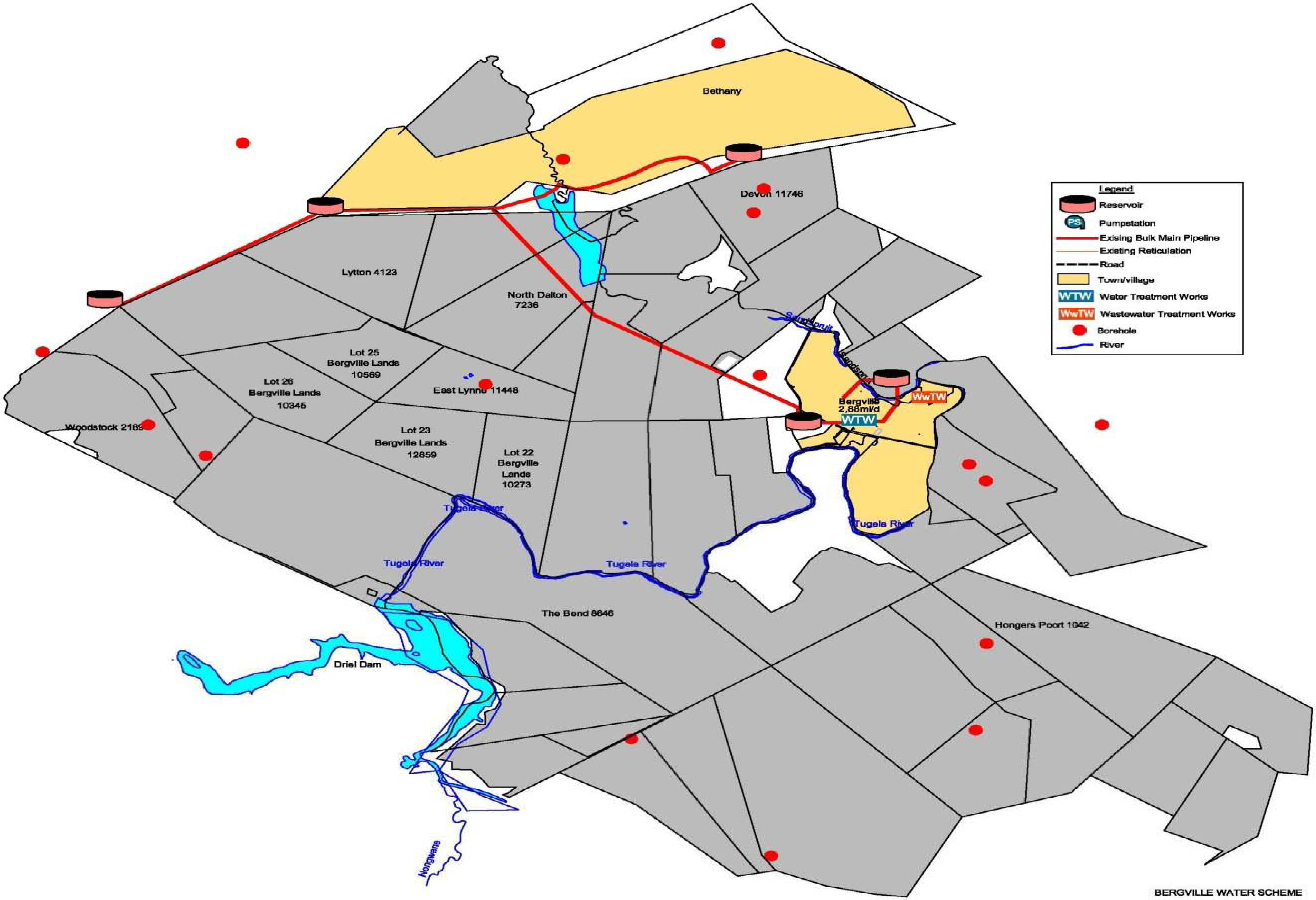


Figure 8 - Schematic layout of Bergville Water Supply Scheme

(Source: First Stage Reconciliation Strategy for Bergville Water Supply Scheme Area Okhahlamba Municipality, 2011)

5.3.1.3 Colenso Water Supply Scheme (Emnambithi/Ladysmith LM)

(Source: First Stage Reconciliation Strategy for Bergville Water Supply Scheme Area Emnambithi/ Ladysmith Municipality, 2011)

The schematic layout of the Colenso Water Supply Scheme indicating the existing bulk water supply infrastructure supplying the area is shown in Figure 9 below.

There are no known major water quality problems in the Colenso Water Supply Scheme area. It is however likely that the quality of the Tugela River is, however, significantly affected during periods of low flow due to the land use activities upstream and soil erosion. The geology and the topography of the area are such that there is limited potential for significant groundwater development. Currently there is limited groundwater use in the Colenso Water Supply Scheme area. The groundwater use is however not registered.

There is no reported water quality problems associated with the groundwater.

The Colenso Water Supply Scheme is supplied by the Colenso WTW which abstracts raw water from the Tugela River through a raw water abstraction works, a pumping station and a raw water pumping main to the water treatment works situated in the town of Colenso.

Water Treatment Works

The Colenso WTW is the only treatment works that supplies the town, with some of the surrounding communities supplemented from boreholes. The peak hydraulic design capacity of the water treatment works is only 2.64 ML/d (WSDP, 2007). The average annual flow rate of the treatment works is estimated to be 1.76 ML/d based on a peaking factor of 1.5.

The Colenso WTW is a conventional treatment plant comprising the following process components:

(i) *Flocculation channels*: The raw water is pumped from the weir on the Tugela River to the inlet works where the chemicals are added as the water flows into the flocculation channels, where coagulation after polyelectrolyte dosing takes place to form the flocs.

(ii) *Clarification (sedimentation) tanks*: The flocs that have formed in the flocculation channels are then settled in the sedimentation tanks under gravity. The settled sludge is removed by frequent de-sludging of the tanks and sent to the sludge lagoons where the sludge is dried, while the supernatant water is discharged back into the river. The plant was not designed for recycling of the wastewater.

(iii) *Rapid Gravity Sand Filtration*: The clarified water is then filtered through a set of rapid gravity sand filters as a final polishing before chlorination of the treated water.

(iv) *Chorine contact tank*: The filtered water is then stored in the chorine contact tanks, where chlorination takes place before pumping the water to the command reservoirs in Colenso town for distribution.

The raw water abstraction has been assumed to be 12% more than the treated water production figures. This has been used to make the projections of the raw water requirements after 2008. The total raw water that was expected to abstracted for treatment at the Colenso WTW in 2008 was estimated as 0.77 million m^3/a (2.12 ML/d) based on the estimated treated water production. The treated water production was provided in the WSDP for 2001 and escalated to 2008 to be 0.68 million m3/a (1.86 ML/d).

As illustrated in Table 5 below, the current utilisation of the bulk water supply infrastructure is approximately 106%. The existing bulk water supply infrastructure is operating above its sustainable level and will not be able to meet the water requirements of the Colenso Water Supply Scheme in the near future.

Treatment Work Name	Type of plant	Raw water source	Hydraulic Design capacity (ML/d)	Average flow rate (ML/d)	Treated water production (ML/d)	Current utilisation (% of ave design capacity)
Colenso WTW	Conventional	Tugela River	2.64	1.76	1.86	106%

Table 5 - Water Treatment Works in operation in the Colenso Water Supply Scheme area
(Source: First Stage Reconciliation Strategy for Bergville Water Supply Scheme Area Emnambithi/ Ladysmith Municipality, 2011)

According to the Blue Drop Report of 2009, there are some operational problems at the treatment works, particularly with seasonal changes to the quality of the raw water as the Colenso treatment works abstracts directly from the Tugela River, which experiences high turbidity levels. The works does not comply with SANS 241, 2001 for potable drinking water quality standards. This is mainly due to significant soil erosion taking place upstream of the abstraction point, resulting in high turbidity levels in summer of 250 NTU (WSDP, 2007).

According to the CIP Report, 2009, the condition of the Colenso WTW can be classified as average. However, there is no information on the performance of the water treatment works infrastructure with respect to its reliability.

Treated water bulk supply infrastructure

The treated water from the Colenso WTW is pumped from the clearwater tanks to various service reservoirs in the scheme before distribution into the scheme's reticulation network (see Figure 9). All pumping systems have standby capacity.

Bulk Storage

The Colenso Water Supply Scheme area has a total reservoir storage capacity estimated at of 1.59 ML supplying the scheme area. The service storage capacity ranges from 0.11 ML pressed steel elevated tanks to 0.5 ML reinforced concrete (RC) service reservoirs in the town of Colenso.

The service storage capacity provides for a 0.85-day or 20.5-hour storage based on the current gross average annual daily demand, but in summer months this reduces to approximately a 13.7-hour storage capacity or 0.57-day storage, based on present treated water requirements (see Table 6Figure 9).

The reservoir storage capacity of Colenso is therefore less than the accepted norm of 48 hours of summer peak requirement for urban areas. This norm has been determined to meet the following requirements:

- Balance the fluctuating demands from the distribution system, permitting the source to give a steady or differently phased output;
- Provide a supply during a failure or shutdown of treatment plant, pumps or bulk mains leading to the reservoir; and
- Provide a reserve of water to meet fire and other emergency demands.

Additional service storage capacity is therefore required in the near future to meet the current and future summer peak requirements.

Parameters	Colenso Water Supply Scheme area
Total Storage capacity (ML)	1.59
Storage Ratio on present annual average consumption (Hours)	20.5
Storage Ratio on present average peak week consumption (Hours)	13.7

Table 6 - Service Storage Reservoir in Colenso Water Supply Scheme area
(Source: First Stage Reconciliation Strategy for Bergville Water Supply Scheme Area Emnambithi/ Ladysmith Municipality, 2011)

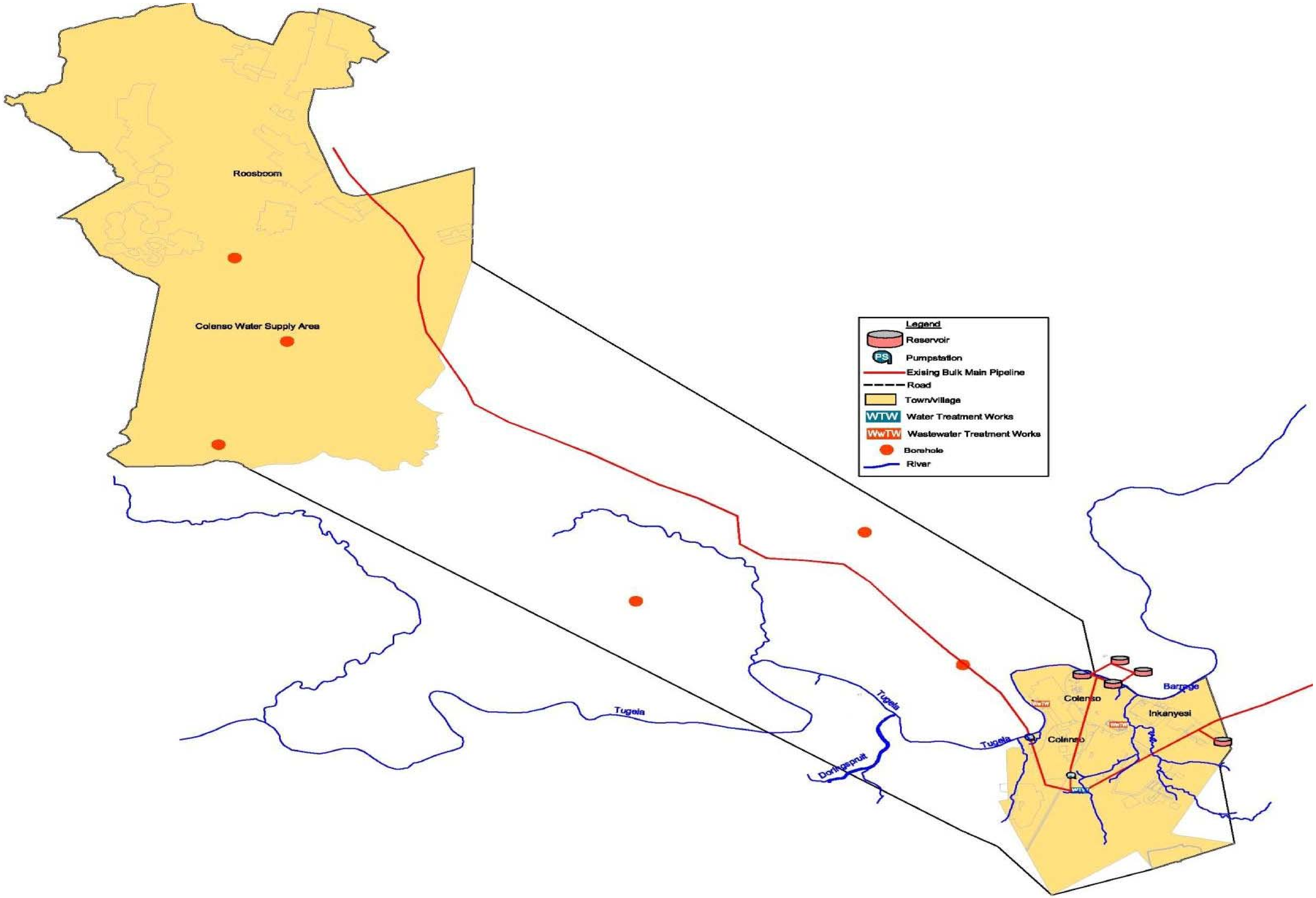


Figure 9 - Schematic layout of Colenso Water Supply Scheme

(Source: First Stage Reconciliation Strategy for Bergville Water Supply Scheme Area Emnambithi/ Ladysmith Municipality, 2011)

5.3.1.4 Ekuvukeni Water Supply Scheme (Indaka LM)

(Source: First Stage Reconciliation Strategy for Ekuvukeni Water Supply Scheme Area Indaka Municipality, 2011)

The schematic layout of the Ekuvukeni Water Supply Scheme indicating the existing bulk water supply infrastructure supplying the area is shown in Figure 10 below.

There are no known major water quality problems in the Ekuvukeni Water Supply Scheme area. It is however likely that the quality of the Sundays River is, however, significantly affected during periods of low flow due to the land use activities upstream and soil erosion, with turbidity also experienced during high rainfall. The geology and the topography of the area are such that there is limited potential for significant groundwater development. Groundwater is used for agricultural purposes, although there is no major groundwater use for domestic purposes in the Ekuvukeni Water Supply Scheme area.

There is no reported water quality problems associated with the groundwater.

The Ekuvukeni Water Supply Scheme is supplied by the Ekuvukeni WTW which abstracts raw water from the Oliphantskop Dam with the raw water abstraction works comprising a pumping station and a raw water pumping main to the water treatment works situated downstream of the dam. The scheme also comprises of bulk service storage infrastructure and bulk distribution networks.

Water Treatment Works

The Ekuvukeni WTW is the only treatment works that supplies the scheme area. The peak hydraulic design capacity of the water treatment works is only 10 ML/d (CIP, 2009). The average annual flow rate of the treatment works is estimated to be 6.67 ML/d based on a peaking factor of 1.5.

The Ekuvukeni WTW is a conventional treatment plant comprising of the following process components:

(i) *Flocculation channels*: The raw water is pumped from the Oliphantskop Dam to the inlet works where the chemicals are added as the water flows into the flocculation channels. Polyelectrolyte dosing takes place, resulting in coagulation to form the flocs.

(ii) *Clarification (sedimentation) tanks*: The flocs that have formed during the flocculation process are then settled in the sedimentation tanks under gravity. The settled sludge is removed by frequent de-sludging of the tanks and sent to the sludge lagoons where the sludge is dried while the supernatant water is discharged back into the river. The plant was not designed for recycling of the wastewater.

(iii) *Rapid Gravity Sand Filtration*: The clarified water is then filtered through a set of rapid gravity sand filters as a final polishing before chlorination of the treated water.

(iv) *Disinfection*: The filtered water is then pumped to the chorine contact tanks where chlorination takes place before pumping the water to the command reservoirs in Ekuvukeni town for distribution.

The total raw water that was expected to be abstracted for treatment at the Ekuvukeni WTW in 2008 was estimated as 3.24 million m^3/a (8.9 ML/d). Based on the estimated raw water requirements, the treated water production with 12% losses was estimated to be 2.85 million m^3/a (7.81 ML/d).

As illustrated in Table 7, the current utilisation of the bulk water supply infrastructure is approximately 117%. The existing bulk water supply infrastructure does not have surplus capacity nor sufficient capacity to be able to meet the future nor current water requirements of Ekuvukeni Water Supply Scheme on a long term sustainable basis.

Treatment Work Name	Type of plant	Raw water source	Hydraulic Design capacity (ML/d)	Average flow rate (ML/d)	Treated water production (ML/d)	Current utilisation (% of ave. design capacity)
Oliphants Kop WTW	Conventional	Oliphantskop Dam	10.00	6.67	7.81	117%

Table 7 - Water Treatment Works in operation in the Ekuvukeni Water Supply Scheme area (Source: First Stage Reconciliation Strategy for Ekuvukeni Water Supply Scheme Area Indaka Municipality, 2011)

According to the WSDP, there were some operational problems at the treatment works due to lack of maintenance. The condition of some of the components were in a very poor state and required urgent refurbishment and maintenance. The performance of the works has been very poor particularly during rainfall seasons when there are changes to the quality of the raw water, with high turbidity levels due to lack of pre-settlement. Furthermore although the plant has dosing equipment, it would appear there was no chlorination taking place. The treatment works is therefore not compliant with SANS 241, 2001 for potable drinking water quality standards. Compliance is also problematic in summer with turbidity levels of 250 NTU (WSDP, 2007).

According to the CIP Report, 2009, the condition of the Ekuvukeni WTW can be classified as very poor. However there is no information on the performance of the water treatment works infrastructure with respect to its reliability.

Treated water bulk supply infrastructure

The treated water from the Ekuvukeni WTW is pumped from the clearwater tanks to various reservoirs in the scheme area before distribution into the scheme's reticulation network (see Figure 10). All pumping systems have standby capacity.

Bulk Storage

The Ekuvukeni Water Supply Scheme area has a total reservoir storage capacity estimated at 23.9 ML supplying the scheme area. The service storage capacity ranges from 1.0 ML to 5.0 ML, all reinforced concrete (RC) service reservoirs (see Table 8).

The service storage capacity provides for a 3.1-day or 73.4-hour storage based on the current gross average annual daily demand, but in summer months this reduces to approximately a 49-hour storage capacity or 2.0-day storage, based on present treated water requirements.

The reservoir storage capacity of Ekuvukeni is therefore within the accepted norm of 48 hours of summer peak requirement for urban areas. This norm has been determined to meet the following requirements:

- Balance the fluctuating demands from the distribution system, permitting the source to give a steady or differently phased output;
- Provide a supply during a failure or shutdown of treatment plant, pumps or bulk mains leading to the reservoir; and
- Provide a reserve of water to meet fire and other emergency demands.

However, as the demands grow in the scheme, additional service storage capacity will be required in the near future to meet the future summer peak requirements of Ekuvukeni Water Supply Scheme.

Parameters	Ekuvukeni Water Supply Scheme area
Total Storage capacity (ML)	23.9
Storage Ratio on present annual average consumption (Hours)	73.4
Storage Ratio on present average peak week consumption (Hours)	49.0

Table 8 - Service Storage Reservoir in Ekuvukeni Water Supply Scheme area
(Source: First Stage Reconciliation Strategy for Ekuvukeni Water Supply Scheme Area Indaka Municipality, 2011)

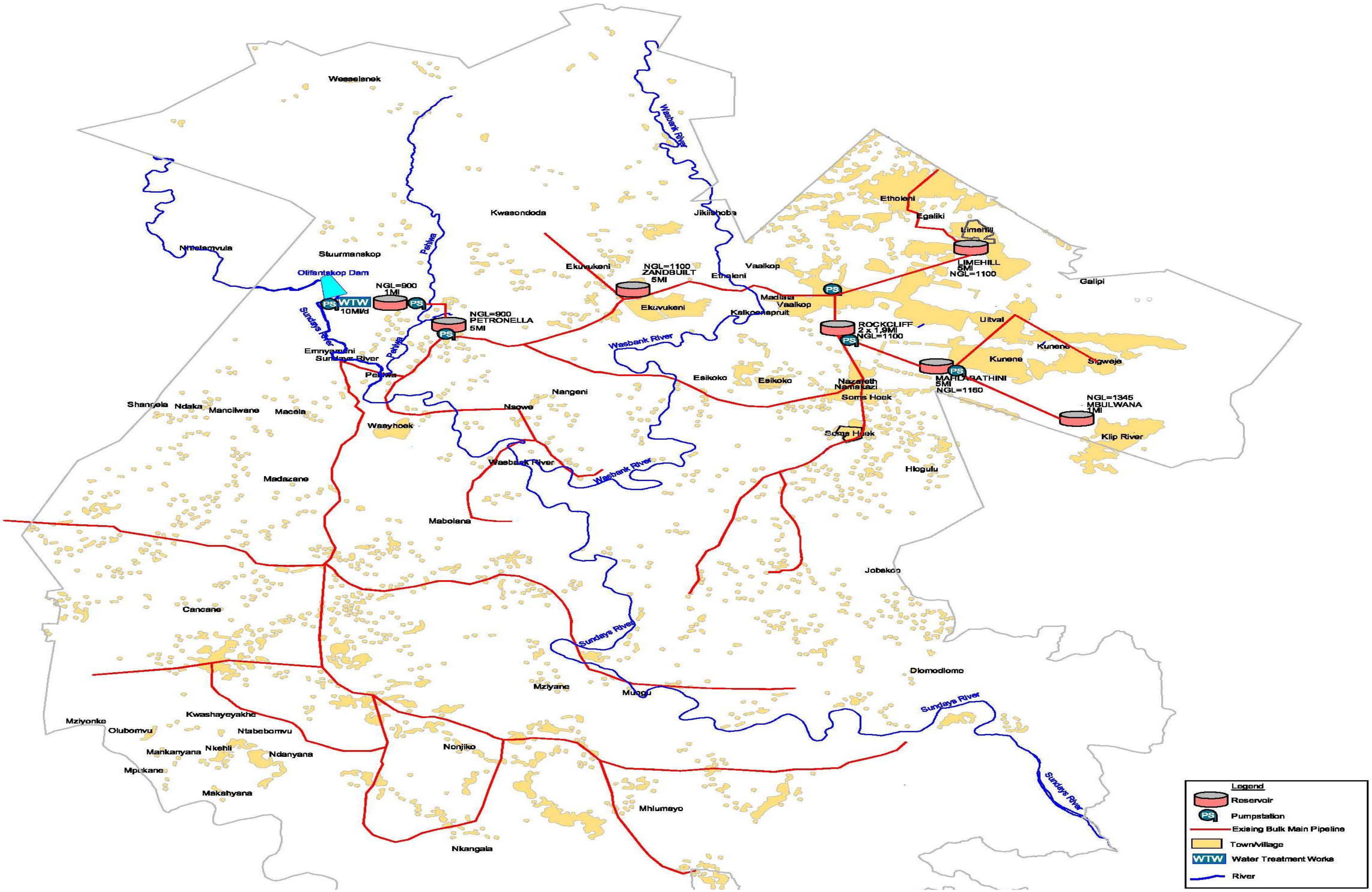


Figure 10 - Schematic layout of Ekuvukeni Water Supply Scheme

(Source: First Stage Reconciliation Strategy for Ekuvukeni Water Supply Scheme Area Indaka Municipality, 2011)

5.3.1.5 Estcourt Water Supply Scheme (Umtshezi LM)

(Source: First Stage Reconciliation Strategy for Escourt Water Supply Scheme Area Umtshezi Municipality, 2011)

The schematic layout of the Estcourt Water Supply Scheme indicating the raw water abstraction, and the bulk water supply infrastructure comprising the water treatment works, the identified service storage reservoirs and bulk supply mains, is shown in Figure 11 below.

There are no known major water quality problems in the Estcourt Water Supply Scheme area. It is however likely that the quality of the Bushmans River may be significantly affected during periods of low flow, owing to the land use activities and soil erosion upstream. The geology and the topography of the area are such that there is limited potential for significant groundwater development. Currently there is no groundwater use for domestic purposes in the Estcourt Water Supply Scheme area.

There are no reported water quality problems associated with the groundwater.

The Estcourt Water Supply Scheme comprises two water treatment works, namely Archie Rodel WTW located in the town of Estcourt and the George Cross WTW which is located of the town, downstream of Wagendrift Dam. The current average treated water production from the existing WTW's that supply the Estcourt Water Supply Scheme, under the current water use practices, including estimated system losses is 13.5 ML/d (4.9 million m^3/a).

Raw water abstraction infrastructure

The Archie Rodel WTW abstracts raw water from the Bushmans River weir. The raw water is then pumped thorough a raw water rising main to the town of Estcourt, where it is treated to potable drinking water quality standards.The capacity of the raw water abstraction works from the Bushmans River is unknown. However, it has been assumed that the existing abstraction works has sufficient capacity to meet the maximum hydraulic design capacity of the WTW of 12 ML/d.

The George Cross WTW abstracts raw water from the Wagendrift Dam from where it is pumped to the water treatment works approximately 3 km downstream for treatment to potable drinking standards. The capacity of the raw water abstraction works from the Wagendrift Dam is unknown. However, it has been assumed that the existing abstraction works has sufficient capacity to meet the maximum hydraulic design capacity of the WTW of 21 ML/d.

Water Treatment Works

The George Cross and Archie Rodel WTW are the two treatment works that supply the town and the surrounding communities, including Wembezi. The total peak hydraulic design capacity of the two water treatment works is 33 ML/d (uThukela District Municipality, 2007a). The total average annual flow rate of the two water treatment works is estimated to be 22 ML/d, based on a peaking factor of 1.5.

Both of the WTWs are conventional treatment plants comprising of the following process components:

(i) *Flocculation channels*: The raw water is supplied to the inlet works where the chemicals are added as the water flows into the flocculation channels. Coagulation takes place after polyelectrolyte dosing to form the flocs.

(ii) *Clarification (sedimentation) tanks*: The flocs that have formed in the flocculation channels are then settled in the sedimentation tanks under gravity. The settled sludge is removed by frequent de-sludging of the tanks and sent to the sludge lagoons where the sludge is dried, while the supernatant water is discharged back into the river. The plants were not designed for recycling of the wastewater.

(iii) *Rapid Gravity Sand Filtration*: The clarified water is then filtered through sets of rapid gravity sand filters as a final polishing before chlorination of the treated water.

(iv) *Chorine contact tank*: The filtered water is then stored in the chorine contact tanks, where chlorination takes place before pumping the water to the command reservoirs in the town of Estcourt for distribution.

The total raw water abstracted for treatment at the Estcourt WTW in 2008 was estimated as 5.6 million m^3/a (15.4 ML/d) based on the treated water production with 12% raw water losses. The treated water production was provided in the WSDP to be 4.9 million m^3/a (13.5 ML/d).

As illustrated in Table 9 below, the current utilisation of the WTWs is approximately 61%. The existing WTW capacity is therefore sufficient to meet the water requirements of the Estcourt Water Supply Scheme area until at least 2018 for the high growth scenario.

Name of Treatment Works	**Type of plant**	**Raw water source**	**Hydraulic Design Capacity (ML/d)**	**Average flow rate (ML/d)**	**Treated water production (ML/d)**	**Current utilisation (% of average design capacity)**
Archie Rodel WTW	Conventional	Bushmans River	12.00	8.00	6.50	81%
George Cross WTW	Conventional	Wagendrift Dam	21.00	14.00	7.00	50%
Total			33.00	22.00	13.50	61.4%

Table 9 - Water Treatment Works in operation in Estcourt area
(Source: First Stage Reconciliation Strategy for Estcourt Water Supply Scheme Area Umtshezi Municipality, 2011).

According to the WSDP (uThukela District Municipality, 2007), there are no operational problems at the two WTWs. However, operational problems may arise due to the seasonal changes to the quality of the raw water, particularly at the Archie Rodel WTW, which abstracts water directly from the Bushmans River. There is significant soil erosion taking place upstream of the abstraction point.

No information is available on the condition and performance of the components of the two WTW’s.

Treated water bulk supply infrastructure

The treated water from the two WTW's in the Estcourt Water Supply Scheme area is pumped from the clearwater tanks to various service reservoirs in Estcourt and Wembezi, before distribution into the reticulation network (see Figure 11). There are booster pumping stations in the scheme area to boost the water to elevated tanks in the low pressure areas of the supply area. All pumping systems have standby capacity.

Bulk Storage

The Estcourt Water Supply Scheme area has a total reservoir storage capacity estimated at of 38.4 ML. The service storage reservoirs range from 0.25 ML pressed steel tanks to a 10 ML reinforced concrete (RC) service reservoir in the town of Estcourt (seeTable 10).

The service storage capacity provides for a 2.8-day or 68-hour storage based on the current gross average annual daily demand, but in summer months this reduces to approximately a 45-hour storage capacity or 1.9-day storage, based on current treated water requirements.

The reservoir storage capacity of the Esctourt Water Supply Scheme area is therefore already slightly less than the accepted norm of 48 hours of summer peak requirement for urban areas. This norm has been determined to meet the following requirements:

- Balance the fluctuating demands from the distribution system, permitting the source to give a steady or differently phased output;
- Provide a supply during a failure or shutdown of treatment plant, pumps or bulk mains leading to the reservoir; and
- Provide a reserve of water to meet fire and other emergency demands.

Additional service storage capacity will therefore be required in the near future to meet the current and future summer peak requirements.

Parameters	Estcourt Water Supply Scheme area
Total Storage capacity (ML)	38.4
Storage Ratio on present annual average consumption (Hours)	68
Storage Ratio on present average peak week consumption (Hours)	45

Table 10 - Service Storage Reservoir in Ekuvukeni Water Supply Scheme area

(Source: First Stage Reconciliation Strategy for Ekuvukeni Water Supply Scheme Area Umtshezi Municipality, 2011)

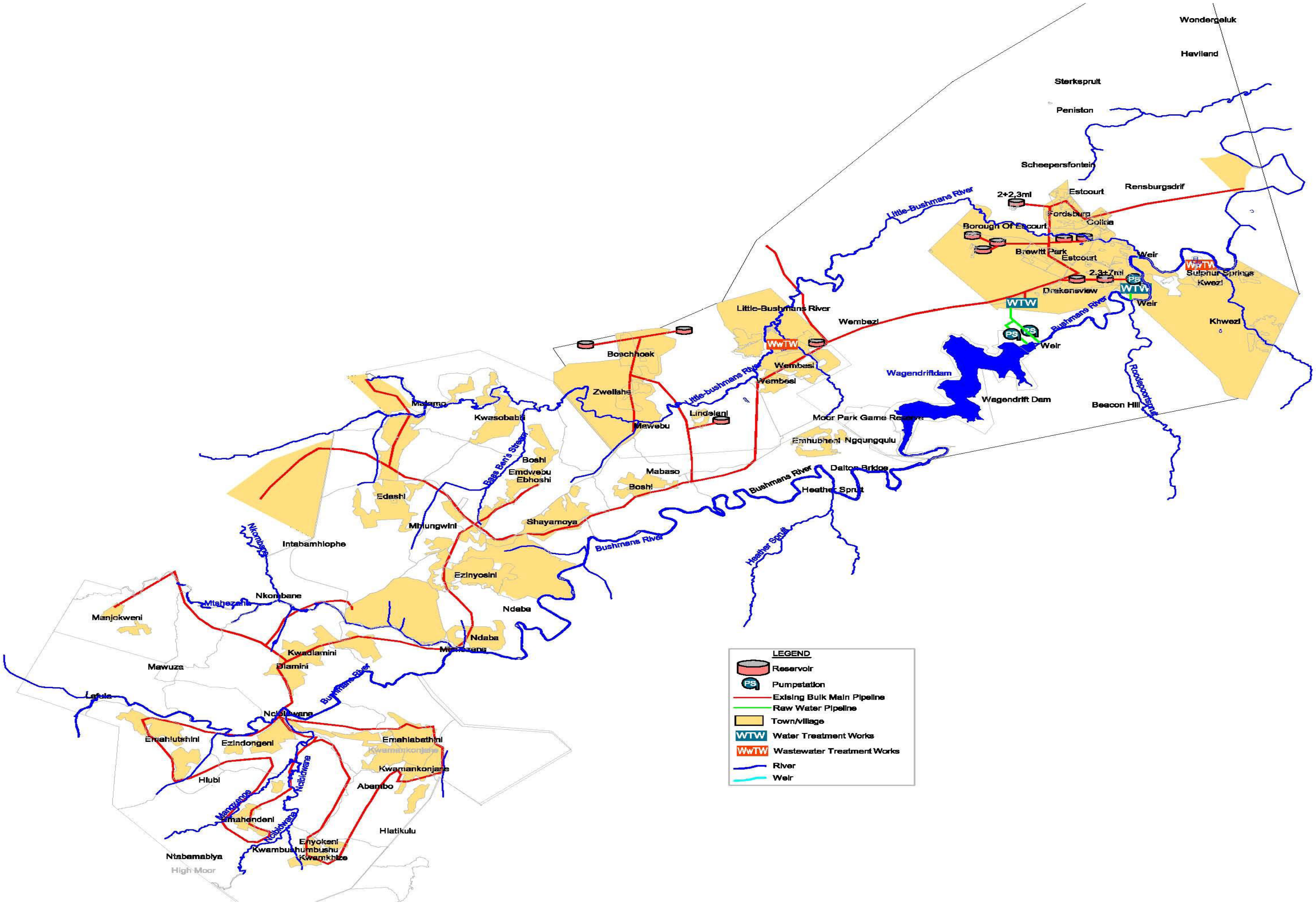


Figure 11 - Schematic layout of Estcourt Water Supply Scheme

(Source: First Stage Reconciliation Strategy for Escourt Water Supply Scheme Area Umtshezi Municipality, 2011)

5.3.1.6 Ezakheni Water Supply Scheme (Emnambithi LM)

(Source: First Stage Reconciliation Strategy for Ezakheni Water Supply Scheme Area Emnambithi Municipality, 2011)

The schematic layout of the Ezakheni Water Supply Scheme area indicating the raw water abstraction and the bulk water supply infrastructure comprising the water treatment works, the identified service storage reservoirs and bulk supply mains supplying the area, is shown in Figure 12 below.

There are no known major water quality problems in the Ezakheni Water Supply Scheme area, except for high turbidity levels in the Tugela River during and after high rainfall periods.The geology and the topography of the area are such that there is no potential for significant groundwater development. Currently there is no groundwater use in the Ezakheni Water Supply Scheme area.

There is no reported water quality problems associated with the groundwater.

The Ezakheni Water Supply Scheme comprises raw water abstraction works from the Tugela River weir, a water treatment works near the river and bulk service storage infrastructure and bulk distribution networks. The current average treated water production from the existing WTW that supplies the Ezakheni Water Supply Scheme under the current water use practices, including estimated system losses, is 30.11 ML/d (11.0 million m^3/a), as shown in **Error! Reference source not found.** below.

Water Treatment Works

The raw water is pumped to the Ezakheni WTW, where it is treated to potable drinking water quality standards. The Ezakheni WTW is the only treatment works that supplies the Ezakheni Water Supply Scheme area. The peak hydraulic design capacity of the water treatment works is 46 ML/d (CIP, 2009). The average annual design treated water capacity of the treatment works is estimated to be 30.67 ML/d (11.2 million m^3/a) based on a peaking factor of 1.5.

The Ezakheni WTW is a conventional treatment plant comprising the following process components:

(i) *Flocculation channels*: The raw water is pumped from the Tugela weir to the inlet works, where the chemicals are added as the water flows into the flocculation channels. Coagulation takes place after polyelectrolyte dosing to form the flocs.

(ii) *Clarification (sedimentation) tanks*: The flocs that have formed during the flocculation process are then settled in the sedimentation tanks under gravity. The settled sludge is removed by frequent de-sludging of the tanks and sent to the sludge lagoons where the sludge is dried, while the supernatant water is discharged back into the river. The plant was not designed for recycling of the wastewater.

(iii) *Rapid Gravity Sand Filtration*: The clarified water is then filtered through a set of rapid gravity sand filters, as a final polishing before chlorination of the treated water.

(iv) *Disinfection*: The filtered water then gravitates to the chorine contact tanks where chlorination takes place, before pumping the potable water to the command reservoirs in the town of Ezakheni for distribution.

The total raw water that was expected to be abstracted for treatment at the Ezakheni WTW in 2008 was estimated as 12.5 million m^3/a (34.2 ML/d). Based on the estimated raw water requirements, the treated water production with 12% losses was estimated to be 10.99 million m^3/a (30.11 ML/d).

As illustrated in Table 11 below, the current utilisation of the Water Treatment Works is approximately 98%, which is already nearly at its design capacity of 30.67 ML/d (11.2 million m^3/a) of treated water or 34.85 ML/d (12.7 million m^3/a) of raw water. Therefore the capacity of the infrastructure is not sufficient to meet the immediate future water requirements of the Ezakheni Water Supply Scheme area on a sustainable basis at the required level of assurance of supply and at the current average per capita consumption without having to impose water restrictions.

Treatment Work Name	Type of plant	Raw water source	Hydraulic Design Capacity (ML/d)	Average Design Capacity (ML/d)	Treated water production (ML/d)	Current utilisation (% of average design capacity)
Ezakheni WTW	Conventional	Tugela River	46.00	30.67	30.11	98%

Table 11 - Water Treatment Works in operation in Ezakheni Water Supply Scheme
(Source: First Stage Reconciliation Strategy for Ezakheni Water Supply Scheme Area Emnambithi Municipality, 2011)

According to the WSDP (uThukela District Municipality, 2007) there were some operational problems at the WTW owing to a lack of maintenance. The condition of some of the components were in a very poor state and required urgent refurbishment and maintenance. The performance of the works has been very poor due to lack of pre-settlement, particularly during periods of high rainfall when there are changes to the quality of the raw water, including high turbidity levels that can be experienced in summer when these can reach levels of 250 NTU according to the WSDP (uThukela District Municipality, 2007). The WTW is therefore not fully compliant with SANS 241, 2001 for potable drinking water quality standards, particularly in the summer.

According to the CIP Report, 2009, the condition of the Ezakheni WTW can be classified as poor. However, there is no information on the performance of the WTW components with respect to their reliability and capacity to meet the level of service for which it was designed.

Treated water bulk supply infrastructure

The treated water from the Water Treatment Works in the Ezakheni Water Supply Scheme is pumped from the clearwater tanks to various service reservoirs in the scheme area, before distribution to the scheme's reticulation network (see Figure 12). There is a booster pumping station in the scheme area to boost the water to some of the reservoirs and the one elevated tank in the low pressure areas of the supply area.

The capacity of the treated water bulk supply infrastructure capacity is not known, but is assumed to be the same as the hydraulic design capacity of the WTW.

All pumping systems have standby capacity.

Bulk Storage

The Ezakheni Water Supply Scheme area has a total reservoir storage capacity estimated at 67 ML for supplying the scheme area. The service storage capacity ranges from 0.5 ML to 10.0 ML, all reinforced concrete (RC) service reservoirs and one elevated tank. (see Table 12).

The service storage capacity provides for a 2.2-day or 53-hour storage based on the current gross average annual daily demand, but in summer months this reduces to approximately a 36-hour or 1.5-day storage capacity.

The reservoir storage capacity of Ezakheni is therefore less than the accepted norm of 48 hours of summer peak requirement for urban areas. This norm has been determined to meet the following requirements:

- Balance the fluctuating demands from the distribution system, permitting the source to give a steady or differently phased output;
- Provide a supply during a failure or shutdown of treatment plant, pumps or bulk mains leading to the reservoir; and
- Provide a reserve of water to meet fire and other emergency demands.

Therefore there is a need to upgrade the reservoir storage capacity immediately.

Parameters	Ezakheni Water Supply Scheme area
Total Storage capacity (ML)	67
Storage Ratio on present annual average consumption (Hours)	53
Storage Ratio on present average peak week consumption (Hours)	36

Table 12 - Service Storage Reservoir in Ezakheni Water Supply Scheme area

(Source: First Stage Reconciliation Strategy for Ezakheni Water Supply Scheme Area Emnambithi Municipality, 2011)

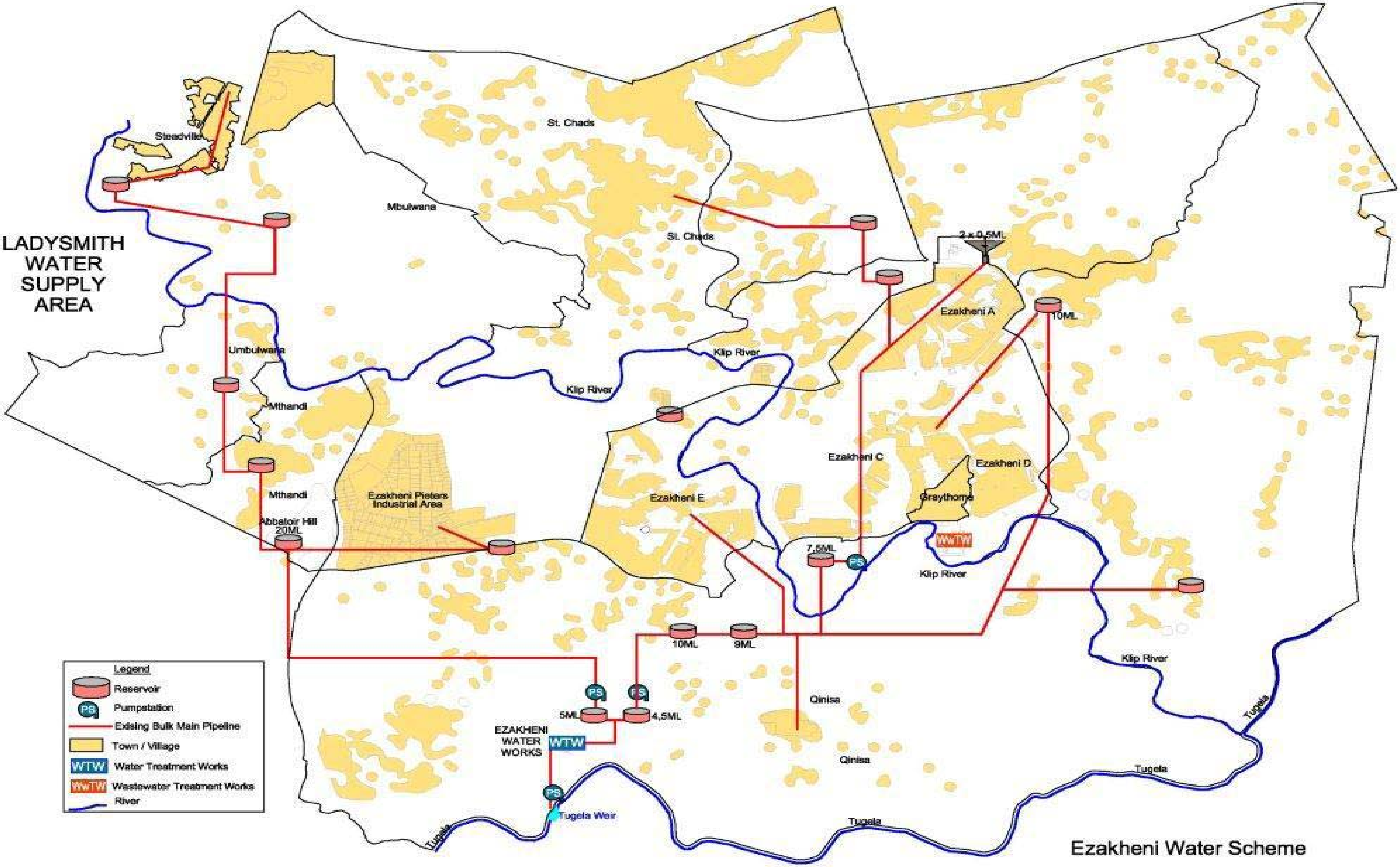


Figure 12 - Schematic layout of Ezakheni Water Supply Scheme area

(Source: First Stage Reconciliation Strategy for Ezakheni Water Supply Scheme Area Emnambithi Municipality, 2011)

5.3.1.7 Ladysmith Water Supply Scheme (Emnambithi/Ladysmith LM)

(Source: First Stage Reconciliation Strategy for Ladysmith Water Supply Scheme Area Emnambithi/ Ladysmith Municipality, 2011)

The Ladysmith Water Supply schematic layout of the infrastructure for residential and non-residential consumption in the area is shown in Figure 13 below.

There are no known major water quality problems in the Ladysmith Water Supply Scheme area. It is however likely that the quality of the Klip River is significantly affected during periods of low flow due to the land use activities upstream and soil erosion. The geology and the topography of the area are such that there is no potential for significant groundwater development. Currently there is no groundwater use in the Ladysmith Water Supply Scheme area.

There is no reported water quality problems associated with the groundwater.

The Ladysmith Water Supply Scheme comprises raw water abstraction from the Klip River and Spioenkop Dam, a water treatment works on the outskirts of the town and bulk service storage infrastructure and distribution networks. The water supply is supplemented by means of a link bulk supply main from the Ezakheni Water Supply through the Steadville Reservoirs which are shared between the two schemes. The Ezakheni Water Supply Scheme draws from a weir on the Tugela River, south of Ezakheni.

The current average treated water production from the existing infrastructure of the Ladysmith Water Supply Scheme under current water use practices, including estimated system losses, as well as the bulk water supply from the Ezakheni Scheme, is 22.4 ML/d (8.2 million m^3/a).

Water Treatment Works

The Ladysmith WTW is the only treatment works that supplies the town and the surrounding communities. Supplementary water is provided from the Ezakheni WTW. The peak hydraulic design capacity of the water treatment works is only 36 ML/d (WSDP, 2007). The average annual flow rate of the treatment works is estimated to be 24 ML/d.

The Ladysmith WTW is a conventional treatment plant comprising of the following process components:

(i) *Flocculation channels*: The raw water is pumped from the Klip River and from Spioenkop Dam to the inlet works where the chemicals are added as the water flows into the flocculation channels where coagulation after polyelectrolyte dosing takes place to form the flocs.

(ii) *Clarification (sedimentation) tanks*: The flocs that have formed in the flocculation channels are then settled in the sedimentation tanks under gravity. The settled sludge is removed by frequent de-sludging of the tanks and sent to the sludge lagoons where the sludge is dried while the supernatant water is discharged back into the river. The plant was not designed for recycling of the wastewater.

(iii) *Rapid Gravity Sand Filtration*: The clarified water is then filtered through a set of rapid gravity sand filters as a final polishing before chlorination of the treated water.

(iv) *Chorine contact tank*: The filtered water is then stored in the chorine contact tanks where chlorination takes place before pumping the water to the command reservoirs in Ladysmith town for distribution.

The total raw water abstracted for treatment at the Ladysmith WTW in 2008 was estimated as 9.3 million m^3/a (25.4 ML/d), based on the treated water production with 12% losses. The treated water production was provided as measured, to be 8.2 million m_3/a (22.4 ML/d).

As illustrated in Table 143 below, the current utilisation of the bulk water supply infrastructure is approximately 77%. The existing bulk water supply infrastructure is therefore sufficient to meet the required treated water production to meet the current water requirements of Ladysmith Water Supply Scheme, until at least 2013.

Name of Treatment Works	Type of plant	Raw water source	Hydraulic Design capacity (ML/d)	Average flow rate (ML/d)	Treated water production (ML/d)	Current utilisation (% of average design capacity)
Ladysmith WTW	Conventional	Spioenkop Dam; Klip River	36.00	24.00	20.00	83%
Ezakheni bulk link	N/A	Tugela River	5.00	5.00	2.35	47%
Total			41.00	29.00	22.35	77.1%

Table 13 - Water Treatment Works in operation in Ladysmith area
(Source: First Stage Reconciliation Strategy for Ladysmith Water Supply Scheme Area Emnambithi/ Ladysmith Municipality, 2011)

It is not known whether there are any operational problems at the treatment works, particularly with seasonal changes to the quality of the raw water, as the Ladysmith treatment works abstracts directly from the Klip River, where there is significant soil erosion taking place upstream of the abstraction point. It is particularly the case with the high turbidity levels that can be experienced in summer with levels of 250 NTU.

No information is available on the condition and performance of the water treatment works infrastructure.

Treated water bulk supply infrastructure
The treated water from the Ladysmith WTW in the Ladysmith Water Supply Scheme is pumped from the clearwater tanks to various service reservoirs in the town before distribution to the town's reticulation network (see Figure 13 below).

Besides the clearwater pumping stations, there are two booster pumping stations identified, pumping treated water to Observation Hill and Rosepark reservoirs. All pumping systems have standby capacity.

Bulk Storage

The Ladysmith Water Supply Scheme area has a total reservoir storage capacity of 97.31 ML supplying the scheme area. The service storage capacity ranges from 0.33 ML steel tanks to 2 x 28 ML reinforced concrete (RC) service reservoirs at Cove Crescent in the town of Ladysmith (see Figure 13Table 14 below).

The service storage capacity provides for a 4.3-day or 104-hour storage based on the current gross average annual daily demand, but in summer months this reduces to approximately a 70-hour storage capacity or 3-day storage, based on present treated water requirements. (see Table 14).

The reservoir storage capacity of Ladysmith is therefore significantly more than the accepted norm of 48 hours of summer peak requirement for urban areas. This norm has been determined to meet the following requirements:

- Balance the fluctuating demands from the distribution system, permitting the source to give a steady or differently phased output;
- Provide a supply during a failure or shutdown of treatment plant, pumps or bulk mains leading to the reservoir; and
- Provide a reserve of water to meet fire and other emergency demands.

Additional service storage capacity is therefore not required in the near future to meet the current and future summer peak requirements.

Parameters	**Ladysmith Water Supply Scheme area**
Total Storage capacity (ML)	97.31
Storage Ratio on present annual average consumption (Hours)	104
Storage Ratio on present average peak week consumption (Hours)	70

Table 14 - Service Storage Reservoir in Ladysmith Water Supply Scheme area
(Source: First Stage Reconciliation Strategy for Ladysmith Water Supply Scheme Area Emnambithi/ Ladysmith Municipality, 2011)

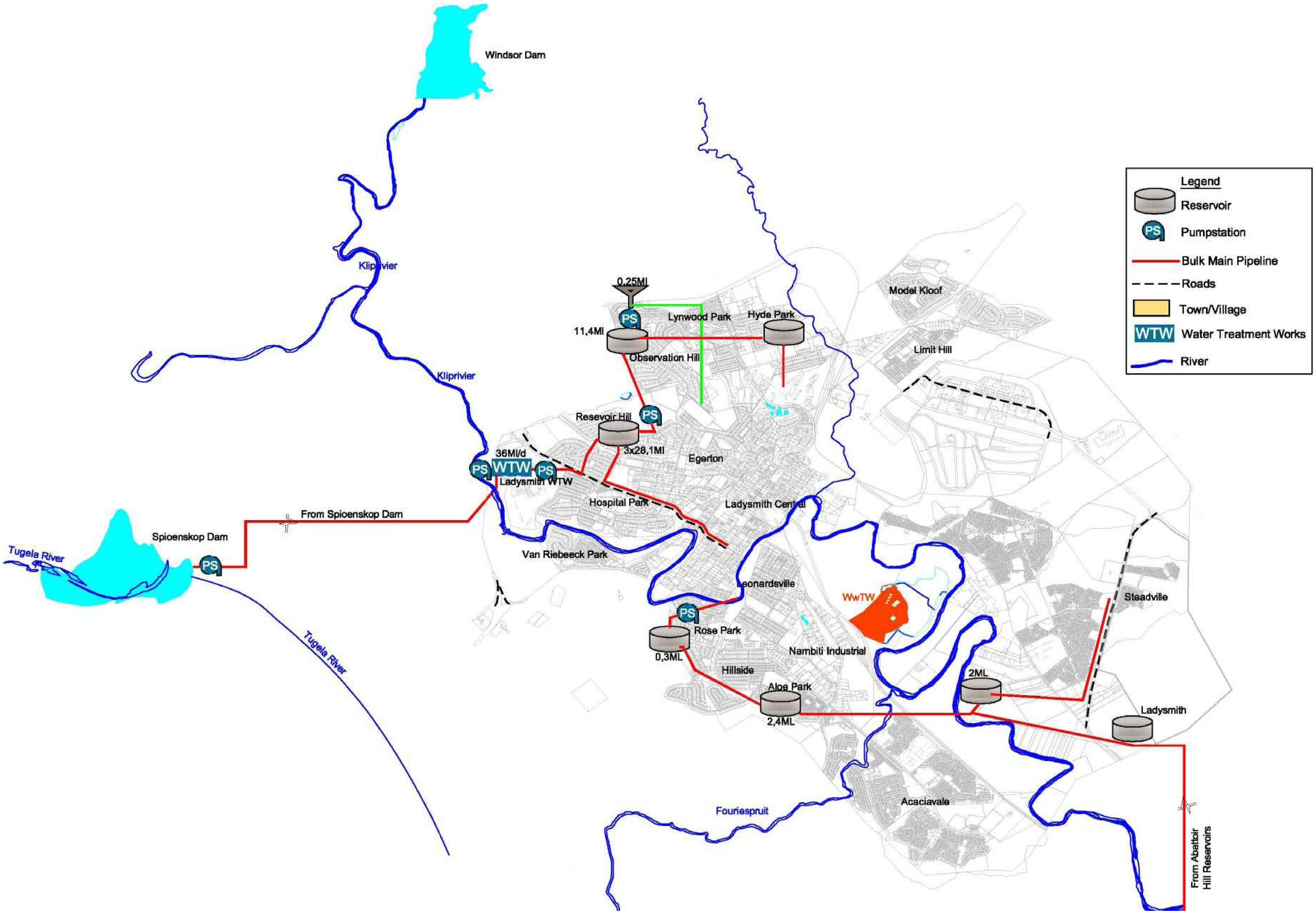


Figure 13 - Schematic layout of Ladysmith Water Supply Scheme

(Source: First Stage Reconciliation Strategy for Ladysmith Water Supply Scheme Area Emnambithi/ Ladysmith Municipality, 2011)

5.3.1.8 Loskop Water Supply Scheme (Imbabazane LM)

(Source: First Stage Reconciliation Strategy for Loskop Water Supply Scheme Area Imbabazane Municipality, 2011)

The schematic layout of the Loskop Water Supply Scheme indicating the existing bulk water supply infrastructure supplying the area is shown in Figure 14 below.

There are no known major water quality problems in the Loskop Water Supply Scheme area. It is however likely that the quality of the Tugela River is, however, significantly affected during periods of low flow due to the land use activities upstream and soil erosion.The geology and the topography of the area are such that there is limited potential for significant groundwater development. Currently there is no groundwater use in the Loskop Water Supply Scheme area.

There is no reported water quality problems associated with the groundwater.

The Loskop Water Supply Scheme comprises raw water abstraction from the little Tugela River, a water treatment works in the rural town and bulk service storage infrastructure and bulk distribution networks.

Water Treatment Works

The Loskop WTW is the only treatment works that supplies the town with some of the surrounding communities supplemented from boreholes. The peak hydraulic design capacity of the water treatment works is only 2.0 ML/d (WSDP, 2007). The average annual flow rate of the treatment works is estimated to be 1.33 ML/d based on a peaking factor of 1.5.

The Loskop WTW comprises the following processes:

(i) *Flocculation channels*: The raw water is pumped from the Little Tugela River to the inlet works of the Plant where the chemicals are added as the water flows into the flocculation channels where coagulation after polyelectrolyte dosing takes place to form the flocs.

(ii) *Clarification (sedimentation) tanks*: The flocs that have formed during the flocculation process are then settled in the sedimentation tanks under gravity. The settled sludge is removed by frequent de-sludging of the tanks and sent to the sludge lagoons where the sludge is dried while the supernatant water is discharged back into the river. The plant was not designed for recycling of the wastewater.

(iii) *Rapid Gravity Sand Filtration*: The clarified water is then filtered through a set of rapid gravity sand filters as a final polishing before chlorination of the treated water.

(iv) *Disinfection*: The filtered water then gravitates to the chorine contact tanks where chlorination takes place before pumping the potable water to the command reservoirs in the scheme area for distribution.

The total raw water abstracted for treatment at the Loskop WTW in 2008 was estimated as 2.07 million m^3/a (5.66 ML/d) based on the estimated treated water production with 12% losses. The treated water production was provided as provided in the WSDP to be 1.82 million m^3/a (4.98 ML/d).

As illustrated in Table 165 below the current utilisation of the bulk water supply infrastructure is approximately 373%. The existing bulk water supply infrastructure is therefore not sufficient to meet the required treated water production for current water requirements of Loskop Water Supply Scheme. There is a likelihood of filter breakthrough which may affect the quality of the treated water.

Treatment Work Name	Type of plant	Raw water source	Hydraulic Design capacity (ML/d)	Average flow rate (ML/d)	Treated water production (ML/d)	Current utilisation (% of ave design capacity)
Loskop WTW	Conventional	Little Tugela River	2.0	1.33	4.98	373%

Table 15 - Water Treatment Works in operation in Loskop area
(Source: First Stage Reconciliation Strategy for Loskop Water Supply Scheme Area Imbabazane Municipality, 2011)

According to the WSDP, 2007, there are many operational problems at the treatment works particularly with seasonal changes to the quality of the raw water as the Loskop treatment works abstracts directly from the little Tugela River where there is significant soil erosion taking place upstream of the abstraction point. The works does not comply with SANS 241, 2001 for potable drinking water quality standards. It is particularly the case with the high turbidity levels that can be experienced in summer with turbidity levels of 188 NTU.

The condition and performance of the water treatment works infrastructure is considered to be very poor.

Treated water bulk supply infrastructure
The treated water from the Loskop WTW in the Loskop Water Supply Scheme is pumped from the clearwater tanks to various service reservoirs in the town before distribution to the town's reticulation network (see Table 16). All pumping systems have standby capacity.

Bulk Storage
The Loskop Water Supply Scheme area has a total reservoir storage capacity estimated at of 7.5 ML supplying the scheme area. The service storage capacity includes a 0.25 ML and 2.0 ML reinforced concrete (RC) service reservoirs in the area of Loskop (see Figure 14 below).

The service storage capacity provides for a 1.5-day or 36-hour storage based on the current gross average annual daily demand, but in summer months this reduces to approximately a 24-hour storage capacity or 1.0-day storage, based on present treated water requirements (see Table 156).

The reservoir storage capacity of Loskop is therefore less than the accepted norm of 48 hours of summer peak requirement for urban areas. This norm has been determined to meet the following requirements:

- Balance the fluctuating demands from the distribution system, permitting the source to give a steady or differently phased output;
- Provide a supply during a failure or shutdown of treatment plant, pumps or bulk mains leading to the reservoir; and
- Provide a reserve of water to meet fire and other emergency demands.

Additional service storage capacity is therefore not required in the near future to meet the current and future summer peak requirements.

Parameters	Loskop Water Supply Scheme area
Total Storage capacity (ML)	7.5
Storage Ratio on present annual average consumption (Hours)	36
Storage Ratio on present average peak week consumption (Hours)	24

Table 16 - Service Storage Reservoir in Losskop Water Supply Scheme area
(Source: First Stage Reconciliation Strategy for Loskop Water Supply Scheme Area Imbabazane Municipality, 2011)

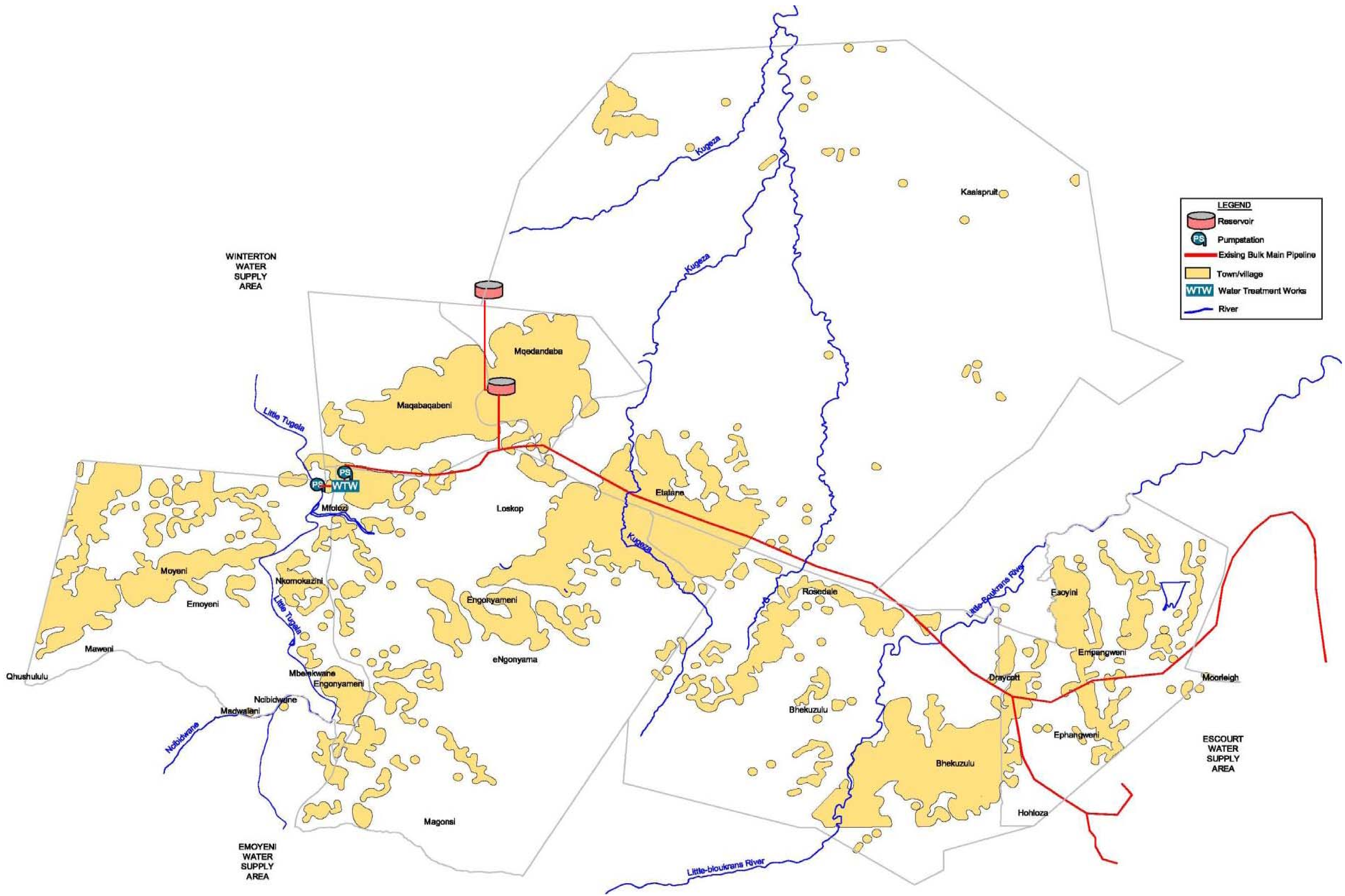


Figure 14 - Schematic layout of Loskop Water Supply Scheme

(Source: First Stage Reconciliation Strategy for Loskop Water Supply Scheme Area Imbabazane Municipality, 2011)

5.3.1.9 Weenen Water Supply Scheme (Umtshezi LM)

(Source: First Stage Reconciliation Strategy for Weenen Water Supply Scheme Area Umtshezi Municipality, 2011)

The schematic layout of the Weenen Water Supply Scheme indicating the existing bulk water supply infrastructure supplying the area is shown in Figure 6.1 below.

There are no known major water quality problems in the Weenen Water Supply Scheme area. It is however likely that the quality of the Bushmans River is, however, significantly affected during periods of low flow due to the land use activities upstream and soil erosion.The geology and the topography of the area are such that there is limited potential for significant groundwater development. Currently there is limited groundwater use for domestic purposes in the Weenen Water Supply Scheme area. Groundwater is mainly being used for agricultural purposes.

There is no reported water quality problems associated with the groundwater.

The Weenen Water Supply Scheme comprises of raw water abstraction supplied by a balancing dam from an irrigation canal supplied from the Bushmans River, a water treatment works in the town and bulk service storage infrastructure and bulk distribution networks.

Water Treatment Works

The Weenen WTW is the only treatment works that supplies the town with some of the surrounding communities supplemented from boreholes. The peak hydraulic design capacity of the water treatment works is 4.0 ML/d (WSDP, 2007). The average annual flow rate of the treatment works is estimated to be 2.67 ML/d based on a peaking factor of 1.5.

The Weenen WTW comprises of the following process components:

(i) *Inline flocculation*: The raw water is pumped from the balancing dam to the inlet works where the chemicals are added as the water flows into the flocculation channels. Coagulation after polyelectrolyte dosing takes place to form the flocs.

(ii) *Clarification (sedimentation) tanks*: The flocs that have formed during the flocculation process are then settled in the sedimentation tanks under gravity. The settled sludge is removed by frequent de-sludging of the tanks and sent to the sludge lagoons where the sludge is dried while the supernatant water is discharged back into the river. The plant was not designed for recycling of the wastewater.

(iii) *High Pressure Sand Filtration*: The clarified water is then filtered through a set of high pressure sand filters as a final polishing before chlorination of the treated water.

(iv) *Chorine contact tank*: The filtered water is then pumped to the chorine contact tanks where chlorination takes place before pumping the water to the command reservoirs in Weenen town for distribution.

The total raw water that was expected to abstracted for treatment at the Weenen WTW in 2008 was estimated as 0.7 million m^3/a (1.9 ML/d) based on the estimated treated water production with 12% losses. The treated water production was provided in the WSDP for 2001 and escalated to 2008 to be 0.61 million m^3/a (1.68 ML/d).

As illustrated in Table 17, the current utilisation of the bulk water supply infrastructure is approximately 63%. The existing bulk water supply infrastructure has surplus capacity which will be sufficient to meet the water requirements of Weenen Water Supply Scheme to 2018.

Treatment Work Name	Type of plant	Raw water source	Hydraulic Design capacity (ML/d)	Average flow rate (ML/d)	Treated water production (ML/d)	Current utilisation (% of ave design capacity)
Weenen WTW	Conventional	Bushmans River	4.00	2.67	1.68	63%

Table 17 - Water Treatment Works in operation in Weenen area

(Source: First Stage Reconciliation Strategy for Weenen Water Supply Scheme Area Umtshezi Municipality, 2011)

According to the Blue Drop Report of 2009, there are some operational problems at the treatment works particularly with seasonal changes to the quality of the raw water as the Weenen treatment works abstracts water with high turbidity levels directly from the balancing dam off the irrigation canal supplying the irrigators. The works does not comply with SANS 241, 2001 for potable drinking water quality standards. It is particularly due to the high turbidity levels that can be experienced in summer with turbidity levels of 250 NTU (WSDP, 2007).

According to the CIP Report, 2009, the condition of the Weenen WTW can be classified as poor. However there is no information on the performance of the water treatment works infrastructure with respect to its reliability.

Treated water bulk supply infrastructure

The treated water from the Weenen WTW in the Weenen Water Supply Scheme is pumped from the clearwater tanks to various service reservoirs in the scheme area before distribution into the scheme's reticulation network (see Figure 15 below). The pumping systems have standby capacity.

Bulk Storage

The Weenen Water Supply Scheme area has a total reservoir storage capacity estimated at of 1.5 ML supplying the scheme area. The service storage capacity ranges from 0.38 ML to 0.5 ML all reinforced concrete (RC) service reservoirs in the supply are of Weenen (see Table 18).

The service storage capacity provides for a 0.9-day or 21-hour storage based on the current gross average annual daily demand, but in summer months this reduces to approximately a 14-hour storage capacity or 0.6-day storage, based on present treated water requirements (see Table 18).

The reservoir storage capacity of Weenen is therefore less than the accepted norm of 48 hours of summer peak requirement for urban areas. This norm has been determined to meet the following requirements:

- Balance the fluctuating demands from the distribution system, permitting the source to give a steady or differently phased output;
- Provide a supply during a failure or shutdown of treatment plant, pumps or bulk mains leading to the reservoir; and
- Provide a reserve of water to meet fire and other emergency demands.

Additional service storage capacity is therefore required to meet the current and future summer peak requirements.

Parameters	Weenen Water Supply Scheme area
Total Storage capacity (ML)	1.5
Storage Ratio on present annual average consumption (Hours)	21
Storage Ratio on present average peak week consumption (Hours)	14

Table 18 - Service Storage Reservoir in Weenen Water Supply Scheme area
(Source: First Stage Reconciliation Strategy for Weenen Water Supply Scheme Area Umtshezi Municipality, 2011)

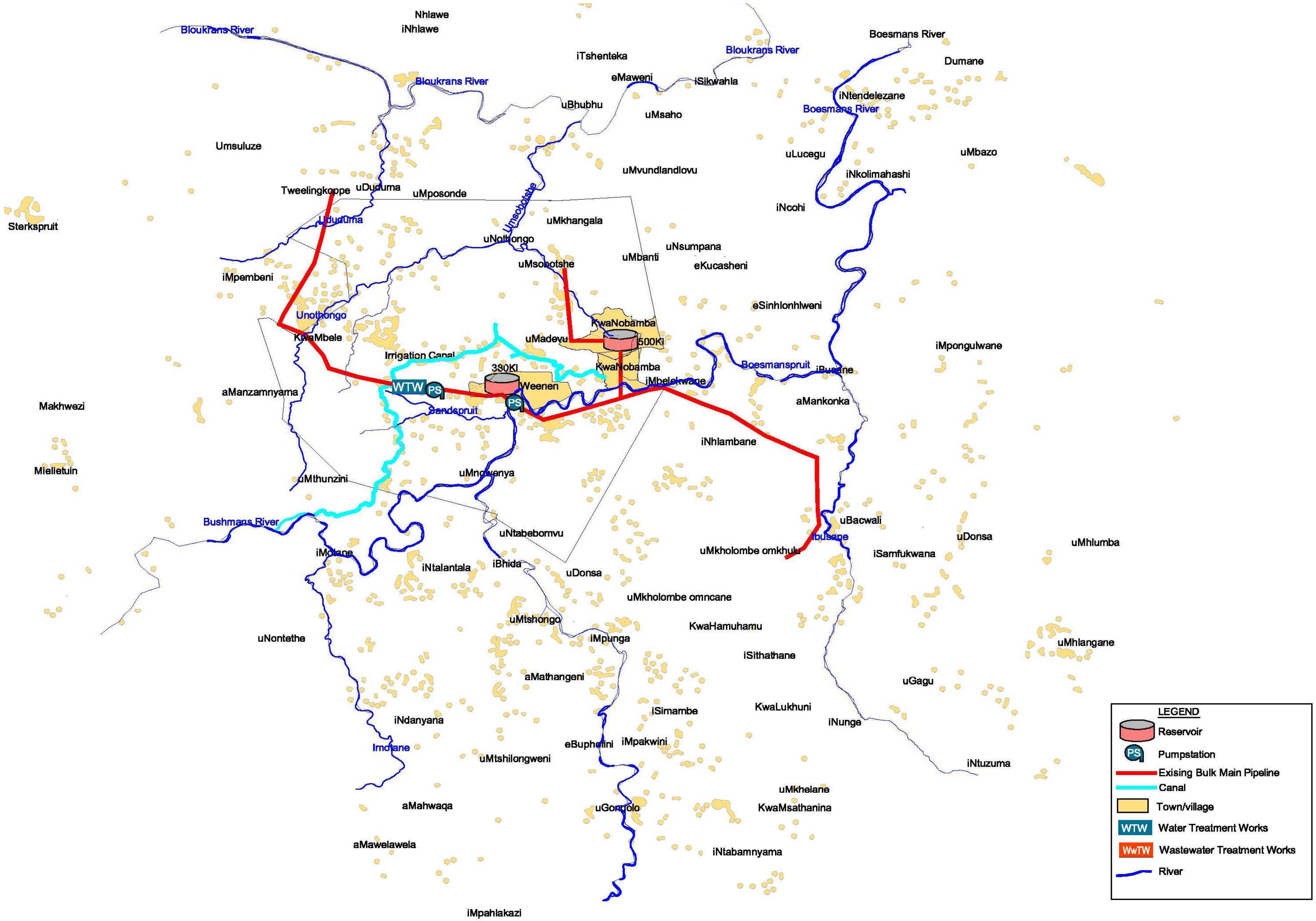


Figure 15 - Schematic layout of Weenen Water Supply Scheme

(Source: First Stage Reconciliation Strategy for Weenen Water Supply Scheme Area Umtshezi Municipality, 2011)

5.3.1.10 Winterton Water Supply Scheme (Okhahlamba LM)

(Source: First Stage Reconciliation Strategy for Winterton Water Supply Scheme Area Okhahlamba Municipality, 2011)

The schematic layout of the Winterton Water Supply Scheme indicating the existing bulk water supply infrastructure supplying the area is shown in Figure 16 below.

There are no known major water quality problems in the Winterton Water Supply Scheme area. It is however likely that the quality of the Tugela River system is, however, significantly affected during periods of low flow due to the land use activities upstream and soil erosion.The geology and the topography of the area are such that there is limited potential for significant groundwater development. Currently there is limited groundwater use in the Winterton Water Supply Scheme area.

There is no reported water quality problems associated with the groundwater.

The Winterton Water Supply Scheme comprises raw water abstraction from a weir in the Little Tugela River, a water treatment works in the town and bulk service storage infrastructure and bulk distribution networks.

Water Treatment Works

The Winterton WTW is the only treatment works that supplies the town. The surrounding communities are supplemented from boreholes. The peak hydraulic design capacity of the water treatment works is only 1.35 ML/d (WSDP, 2007). The average annual flow rate of the treatment works is estimated to be 0.9 ML/d based on a peaking factor of 1.5.

The Winterton WTW comprises of two processes, namely:

(i) Slow Sand Filters: These are a batch process with the filters operated and cleaned periodically. The raw water from the Little Tugela is pumped to the slow sand filters where the water is filtered at a very slow rate. The majority of the suspended solids are removed in the top 2 to 3 cm of the bed. This layer is known as the *schmutzdecke* or "dirty mat". This layer contains a large variety of microorganisms and enables the removal of bacteria, organic matter and reduces turbidity of the raw water. The filters are cleaned by scraping a thin layer of sand off its surface. Backwashing is not employed as this will restratify the bed hydraulically.

(ii) *Pressure filters*: These are cylindrical pressure vessels that are fabricated exclusively from steel plates. The raw water is pumped directly into the pressure filters for filtration at higher rates than normal gravity filters.

(iii) *Chorine contact tank*: The filtered water is then stored in the chorine contact tanks, where chlorination takes place before pumping the water to the command reservoirs in Winterton town, for distribution

The total raw water abstracted for treatment at the Winterton WTW in 2008 was estimated as 0.26 million m^3/a (0.71 ML/d) based on the estimated treated water production with 12% losses. The treated water production was provided in the WSDP to be 0.23 million m^3/a (0.63 ML/d).

As illustrated in Table 19 below, the current utilisation of the bulk water supply infrastructure is approximately 69%. The existing bulk water supply infrastructure is therefore sufficient to meet the required treated water production to meet the current and future water requirements of Winterton Water Supply Scheme until at least 2015.

Treatment Work Name	**Type of plant**	**Raw water source**	**Hydraulic Design capacity (ML/d)**	**Average flow rate (ML/d)**	**Treated water production (ML/d)**	**Current utilisation (% of ave. design capacity)**
Winterton WTW	Conventional	Little Tugela River	1.35	0.90	0.63	69%

Table 19 - Water Treatment Works in operation in Winterton area
(Source: First Stage Reconciliation Strategy for Winterton Water Supply Scheme Area Okhahlamba Municipality, 2011)

According to the WSDP, 2007, there are operational problems at the treatment works, particularly with seasonal changes to the quality of the raw water. This is because the Winterton treatment works abstracts directly from the Little Tugela River, which experiences significant soil erosion upstream of the abstraction point. The works does not comply with SANS 241, 2001 for potable drinking water quality standards. This is due to the high turbidity levels that can be experienced in summer, with turbidity levels of 80 NTU.

No information is available on the condition and performance of the water treatment works infrastructure.

Treated water bulk supply infrastructure
The treated water from the treatment works in the Winterton Water Supply Scheme is pumped from the clearwater tanks to various service reservoirs in the town, before distribution into the town's reticulation network (see Figure 16 below).

All pumping systems have standby capacity.

Bulk Storage
The Winterton Water Supply Scheme area has a total reservoir storage capacity estimated at of 1.5 ML supplying the scheme area. The service storage capacity includes a 0.5 ML and 1.0 ML reinforced concrete (RC) service reservoirs in the town of Winterton (see Figure 16Table 20).

The service storage capacity provides for a 2.4-day or 58-hour storage based on the current gross average annual daily demand, but in summer months this reduces to approximately a 39-hour storage capacity or 1.6-day storage, based on present treated water requirements (see Table 20).

The reservoir storage capacity of Winterton is therefore less than the accepted norm of 48 hours of summer peak requirement for urban areas. This norm has been determined to meet the following requirements:

- Balance the fluctuating demands from the distribution system, permitting the source to give a steady or differently phased output;
- Provide a supply during a failure or shutdown of treatment plant, pumps or bulk mains leading to the reservoir; and
- Provide a reserve of water to meet fire and other emergency demands.

Additional service storage capacity is therefore required in the near future to meet the current and future summer peak requirements.

Parameters	**Winterton supply area**
Total Storage capacity (ML)	1.5
Storage Ratio on present annual average consumption (Hours)	58
Storage Ratio on present average peak week consumption (Hours)	39

Table 20 - Service Storage Reservoir in Winterton Water Supply Scheme area

(Source: First Stage Reconciliation Strategy for Winterton Water Supply Scheme Area Okhahlamba Municipality, 2011)

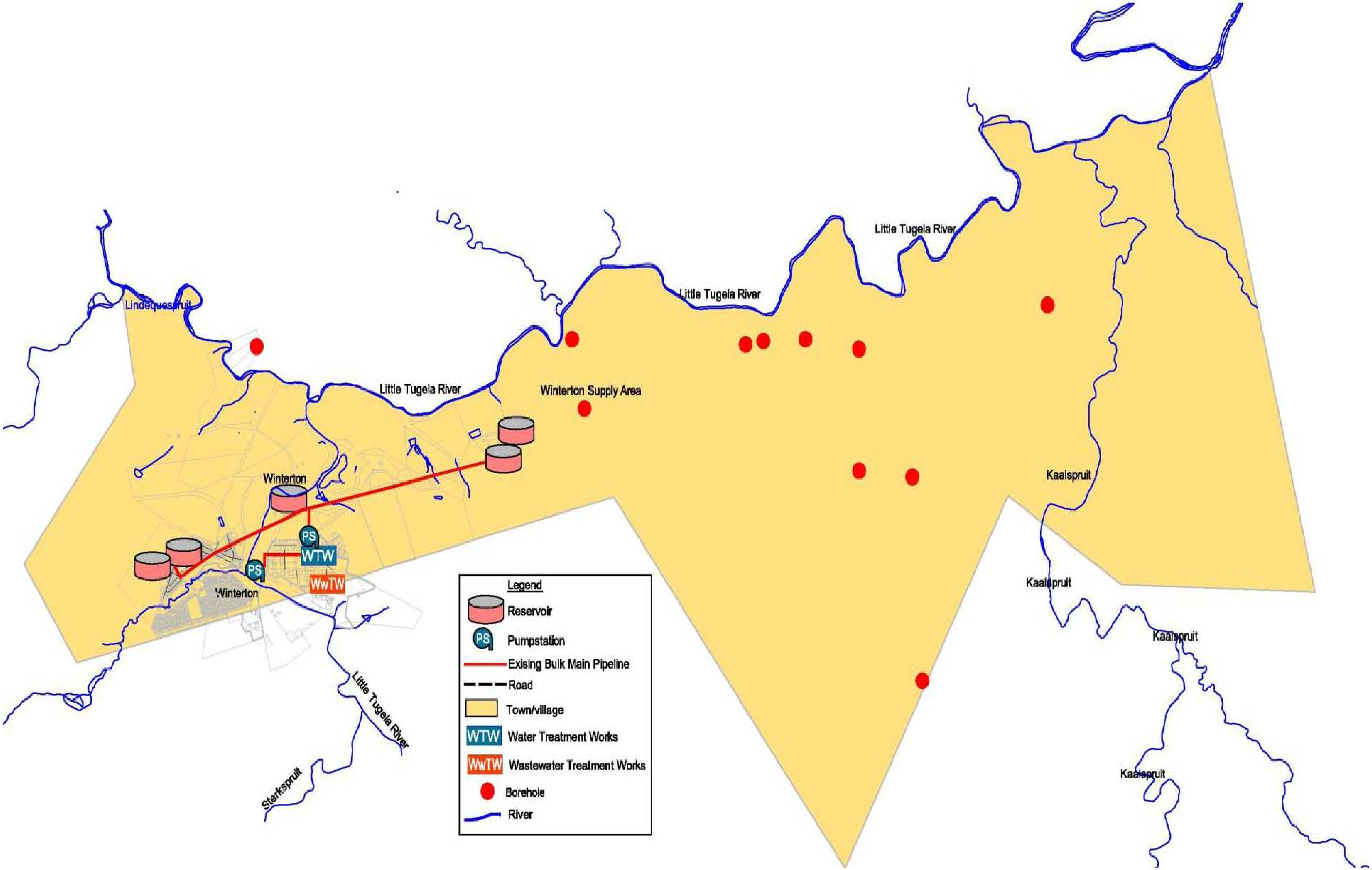


Figure 16 - Schematic layout of Winterton Water Supply Scheme

(Source: First Stage Reconciliation Strategy for Winterton Water Supply Scheme Area Okhahlamba Municipality, 2011)

6. RECONCILIATION OF EXISTING AND PROPOSED WATER SUPPLY AND DEMAND OPTIONS

GIS analysis was used to calculate both high and low household counts, as well as high and low population counts, for each water demand area. While the calculation of the household counts for each area was a simple GIS query, the population statistics, and projection thereof, required more detailed analysis.

Household Counts:

Unique ID numbers were given to all the demand areas, which could then be used to link data from other sources. A spatial join was performed on the Eskom 2011 household points falling within each polygon. This gave each household point the unique ID of the polygon in which it fell. This data could then be summarised and a count done of the number of households in each water supply footprint. This count was then added to the water demand attribute table

Table

footprint_pop_2014

OID	UID	Cnt_UID	Sum_HH_2014
4698	Uthukela_1297	17	80.75
4699	Uthukela_1298	18	113.94
4700	Uthukela_1299	75	474.72
4701	Uthukela_13	32	176.32
4702	Uthukela_130	91	555.1
4703	Uthukela_1300	12	54.12
4704	Uthukela_1301	44	207.71
4705	Uthukela_1302	23	107.87
4706	Uthukela_1303	49	231.28
4707	Uthukela_1304	94	469.06
4708	Uthukela_1305	740	3692.6
4709	Uthukela_1306	66	329.34
4710	Uthukela_1307	663	3135.84
4711	Uthukela_1308	363	1833.15
4712	Uthukela_1309	65	331.8
4713	Uthukela_131	72	427.68
4714	Uthukela_1310	12	62.64
4715	Uthukela_1311	118	558.7
4716	Uthukela_1312	3097	12621.9
4717	Uthukela_1313	45	238.05
4718	Uthukela_1314	289	1479.68
4719	Uthukela_1315	357	1282.41
4720	Uthukela_1316	42	243.6
4721	Uthukela_1317	38	209.38

Table 21: Example of household data with unique water supply footprint identifier

These figures were used as the “Low” count, until the “High” had been calculated. The high count was obtained by extrapolating the growth rate for each ward from the Census 2001/2011 figure through to 2014. This information was obtained using the online Statistics SA Superweb application. Statistics SA was consulted on the best method in achieving these calculations. The 73 wards falling within Uthukela District Municipality were selected, and the population figures for both 2001 and 2011 were added to the table. These two figures were used to calculate the percentage growth over that ten year period. The result was divided by 10 to get an average growth rate per annum for each ward.

This growth rate was then applied to the household count for each subsequent year (2012, 2013, 2014), and the result was used to populate the “High” values for both population and number of households in the attribute table. Once the high count had been completed, the two figures could be compared. Where “Low” > “High”, the figures were swapped. Since the calculations for high and low demand for water were based on the required million m³ per annum, the number of decimal places in the household count was significant, and the project team made the decision to keep this to two decimal places.

Table

hholds_with_UID_pop_growth_hhold_size

Id	DM	UID	GrPA_2	Pop2012	Pop2013	Pop2014	Av_HHSize	OH_Cmmts	HH_2012	HH_2013	HH_2014
349	Uthukela	Uthukela_349	0.27	10101.1998	10128.473039	10155.819917	5.57		5.59	5.61	5.63
349	Uthukela	Uthukela_349	0.27	10101.1998	10128.473039	10155.819917	5.57		5.59	5.61	5.63
350	Uthukela	Uthukela_350	0.27	10101.1998	10128.473039	10155.819917	5.57		5.59	5.61	5.63
350	Uthukela	Uthukela_350	0.27	10101.1998	10128.473039	10155.819917	5.57		5.59	5.61	5.63
369	Uthukela	Uthukela_369	0.27	10101.1998	10128.473039	10155.819917	5.57		5.59	5.61	5.63
370	Uthukela	Uthukela_370	0.27	10101.1998	10128.473039	10155.819917	5.57		5.59	5.61	5.63
370	Uthukela	Uthukela_370	0.27	10101.1998	10128.473039	10155.819917	5.57		5.59	5.61	5.63
370	Uthukela	Uthukela_370	0.27	10101.1998	10128.473039	10155.819917	5.57		5.59	5.61	5.63
370	Uthukela	Uthukela_370	0.27	10101.1998	10128.473039	10155.819917	5.57		5.59	5.61	5.63
371	Uthukela	Uthukela_371	0.27	10101.1998	10128.473039	10155.819917	5.57		5.59	5.61	5.63
372	Uthukela	Uthukela_372	0.27	10101.1998	10128.473039	10155.819917	5.57		5.59	5.61	5.63
551	Uthukela	Uthukela_551	0.27	10101.1998	10128.473039	10155.819917	5.57		5.59	5.61	5.63
554	Uthukela	Uthukela_554	0.27	10101.1998	10128.473039	10155.819917	5.57		5.59	5.61	5.63
557	Uthukela	Uthukela_557	0.27	10101.1998	10128.473039	10155.819917	5.57		5.59	5.61	5.63
557	Uthukela	Uthukela_557	0.27	10101.1998	10128.473039	10155.819917	5.57		5.59	5.61	5.63
561	Uthukela	Uthukela_561	0.27	10101.1998	10128.473039	10155.819917	5.57		5.59	5.61	5.63
711	Uthukela	Uthukela_711	0.27	10101.1998	10128.473039	10155.819917	5.57		5.59	5.61	5.63
713	Uthukela	Uthukela_713	0.27	10101.1998	10128.473039	10155.819917	5.57		5.59	5.61	5.63
713	Uthukela	Uthukela_713	0.27	10101.1998	10128.473039	10155.819917	5.57		5.59	5.61	5.63
713	Uthukela	Uthukela_713	0.27	10101.1998	10128.473039	10155.819917	5.57		5.59	5.61	5.63
714	Uthukela	Uthukela_714	0.27	10101.1998	10128.473039	10155.819917	5.57		5.59	5.61	5.63
714	Uthukela	Uthukela_714	0.27	10101.1998	10128.473039	10155.819917	5.57		5.59	5.61	5.63
716	Uthukela	Uthukela_716	0.27	10101.1998	10128.473039	10155.819917	5.57		5.59	5.61	5.63
716	Uthukela	Uthukela_716	0.27	10101.1998	10128.473039	10155.819917	5.57		5.59	5.61	5.63

Population Numbers:

Census 2011 data was used for the population figures. The Supercross programme was used to extract the household sizes and the total population counts for each subplace within the District. The total population was divided by the number of households (from the Eskom 2011 point data) to get the average household size.

This household size data was then linked to the household points, again using a spatial join in ArcGIS. Using the unique ID, the data was summarised and the number of people (a sum of the household size in each demand area) was calculated. This was joined to the demand area attribute table, and used as the low population count. In the same way as the growth of the number of households was calculated, the growth rate was applied to the population figures, and the result was again summarised, population figures summed, and this data added as the high population figure.

DM	HH_Low	HH_High	Pop_Low	Pop_High
Uthukela	11	11	57	59
Uthukela	7	7	39	40
Uthukela	7	7	39	41
Uthukela	4	4	22	24
Uthukela	9	9	50	53
Uthukela	10	10	51	53
Uthukela	24	25	122	127
Uthukela	11	11	56	58
Uthukela	8	8	41	42
Uthukela	20	20	103	105
Uthukela	10	10	51	53
Uthukela	11	12	62	65
Uthukela	9	10	45	49
Uthukela	6	6	27	29
Uthukela	3	3	13	15
Uthukela	5	5	22	25
Uthukela	6	7	32	34
Uthukela	38	41	180	194
Uthukela	36	39	640	698
Uthukela	5	5	82	90
Uthukela	19	20	91	94
Uthukela	5	5	27	28
Uthukela	15	15	73	73
Uthukela	13	14	55	58
Uthukela	7	7	39	39
Uthukela	7	7	39	39
Uthukela	9	9	50	50
Uthukela	7	7	39	39
Uthukela	6	6	33	34
Uthukela	12	12	66	67
Uthukela	5	5	28	28

Table 22: Example of low and high household and population statistics

Water Demand Forecasts

The higher of the two household counts was used to calculate the low demand forecast (million m³ pa), using the figures supplied by the Department of Water Affairs using the All Town Study. The high demand forecast (million m³ pa) was calculated in the same way. The probable demand forecast (million m³ pa) was the average of these two figures.

DM	LowDemandForecast	HighDemandForecast	ProbableDemand	CurrentWaterRequirements	FutureWaterRequirements
Uthukela	0.002497	0.004738	0.003537	0.003537	0.004738
Uthukela	0.002562	0.004015	0.003246	0.003246	0.004015
Uthukela	0.002562	0.004115	0.003246	0.003246	0.004115
Uthukela	0.001445	0.002409	0.001831	0.001831	0.002409
Uthukela	0.003285	0.00532	0.004161	0.004161	0.00532
Uthukela	0.002234	0.004256	0.003165	0.003165	0.004256
Uthukela	0.005344	0.010198	0.00757	0.00757	0.010198
Uthukela	0.002453	0.004657	0.003475	0.003475	0.004657
Uthukela	0.001796	0.003373	0.002544	0.002544	0.003373
Uthukela	0.006767	0.010539	0.008572	0.008572	0.010539
Uthukela	0.002234	0.004256	0.003165	0.003165	0.004256
Uthukela	0.004073	0.006524	0.00516	0.00516	0.006524
Uthukela	0.001971	0.003935	0.002792	0.002792	0.003935
Uthukela	0.001183	0.002329	0.001675	0.001675	0.002329
Uthukela	0.000569	0.001205	0.000807	0.000807	0.001205
Uthukela	0.000964	0.002008	0.001365	0.001365	0.002008
Uthukela	0.002102	0.003413	0.002663	0.002663	0.003413
Uthukela	0.007884	0.015578	0.011169	0.011169	0.015578
Uthukela	0.028032	0.056049	0.039712	0.039712	0.056049
Uthukela	0.003592	0.007227	0.005088	0.005088	0.007227
Uthukela	0.003986	0.007548	0.005647	0.005647	0.007548
Uthukela	0.001774	0.002811	0.002247	0.002247	0.002811
Uthukela	0.003197	0.005862	0.00453	0.00453	0.005862
Uthukela	0.003614	0.005822	0.004577	0.004577	0.005822
Uthukela	0.001708	0.003132	0.00242	0.00242	0.003132
Uthukela	0.001708	0.003132	0.00242	0.00242	0.003132
Uthukela	0.00219	0.004015	0.003102	0.003102	0.004015
Uthukela	0.001708	0.003132	0.00242	0.00242	0.003132
Uthukela	0.001445	0.00273	0.002048	0.002048	0.00273
Uthukela	0.002891	0.00538	0.004095	0.004095	0.00538
Uthukela	0.001226	0.002248	0.001737	0.001737	0.002248
Uthukela	0.002956	0.004718	0.003745	0.003745	0.004718

Water Supply Status and Water Source

The supply status of each area was assessed using all available spatial water infrastructure data, and intersections with the water demand polygons. Where there were intersections it was assumed that there was short term supply to that area. Assessments were checked manually to ensure that very close water supplies to settlement boundaries were taken into account.

Similarly, analysis using existing mapped boreholes and other water sources, was used to populate the existing water source field.

LOCAL MUNICIPALITY	NO OF WATER SUPPLY FOOTPRINTS	NO OF AREAS WITH SHORT TERM SUPPLY
Okhahlamba	493	184
Emnambithi/Ladysmith	216	109
Indaka	258	133
Umtshezi	242	70
Imbabazane	103	68
Uthukela	1312	564

6.1 Existing Water and Sanitation Infrastructure

The table below is a summary of the water infrastructure components available in UTDM as stated in WSDP (2007).

Component	Emnambithi LM	Indaka LM	Umtshezi LM	Okhahlamba LM	Imbabazane LM	uThukela DM
Surface water resources	3	3	3	11	3	23
Groundwater resources	7	4	2	23	11	47
Abstraction	3	3	3	10		20
Water treatment works	3	2	3	3	0	10
Pump stations	17	6	18	8	13	62
Bulk lines	Unknown	Unknown	Unknown	Unknown		Uknown
Reticulation lines	unknown					Uknown
Reservoirs	25	15	21	15		76
Wastewater treatment works	3	1	1	0	0	5
Oxidation Ponds			2	1	0	3
Zones	18	20	6	17	14	75

Table 23 - Summary of water infrastructure

(Source : WSDP 2007)

Table 24 indicates the capacities of the Water Treatment Works in the various municipalities. This table was extracted from the Blue Drop Report which was undertaken in 2012.

Water Treatment Works		Design Capacity ML/d	Operational Capacity (% ito Design)
1	Ladysmith	18	155.56
2	Ezakheni	32	140.63
3	Colenso	2.64	90.91
4	Loskop	1.2	100
5	Ekuvukeni	10.0	80
6	Tugela Estates	2	100
7	Winterton	1.2	66.67
8	Bergville	3.6	88.89
9	Langkloof	0.4	100
10	Zwelisha	4	60
11	George Cross	21	85.71
12	Archie Rodel	12	43.33
13	Weenen	1.45	100

Table 24 - Assessment of Water Treatment Works

(Source : Blue Drop Report 2012)

Table 25 indicates the capacities of the various Waste Water Treatment Works in UTDM. This table was extracted from the Green Drop Report which was undertaken in 2012.

Waste Water Treatment Works		**Design Capacity**
		ML/d
1	Bergville	0.4
2	Colenso	3.2
3	Ezakheni	12
4	Ekuvukeni	2.4
5	Estcourt	20
6	Ladysmith	0.00
7	Weenen Ponds	Unknown
8	Wembezi	1.25
9	Winterton	0.5

Table 25 - Assessment of Waste Water Works

(Source : Green Drop Report 2012)

6.2 Water and Sanitation Backlogs

Table 26 indicates the total number of households as well as water backlogs within the various local municipalities in the UTDM.

Water	Total Households	Backlogs (households)
Okhahlamba	22011	22 841
Ladysmith / Emnambithi	39573	27 051
Indaka	17186	22 914
Umtshezi	13859	5 195
Imbabazane	18846	18 112
uThukela	**111475**	**96 113**

Table 26 - Water Backlogs

(Source: Eskom study 2011 and Stats SA)

Table 27 indicates the total number of households as well as sanitation backlogs within the various local municipalities in the UTDM.

Sanitation	**Total Households**	**Backlogs**
Okhahlamba	22011	8 704
Ladysmith / Emnambithi	39573	5 443
Indaka	17186	4 320
Umtshezi	13859	6 435
Imbabazane	18846	7005
uThukela	**111475**	**31 907**

Table 27 - Sanitation Backlogs

(Source: Stats SA and IDP 2013)

7. PROPOSED FUTURE SUPPLY OPTIONS

7.1 Existing proposals for future supply

The table below indicates the estimated MIG budgets for projects in the UTDM one year operational plan.

Table 28 contains information on the budgets required to undertake the various water projects within the local municipalities. It also indicates the budget allocated by the various sources of funding for each of the projects listed. The table also provides a brief description of the projects. This information was extracted from the IDP undertaken in 2013.

LOCAL MUNICIPALITY	WARD	PROJECT DESCRIPTION	BUDGET
Emnambithi/Ladysmith	14, 15, 16, 17, 18	Driefontein upgrading of Burford water supply scheme	R 28,000,000.00
Kwanobamba/Ezitendeni	5;7 &8	Water Supply Scheme	R 35,000,000.00
Okhahlamba	13	Bergville Phase 2 water Supply	R10,086,071.10
Imbabazane		Bhekuzulu / Ephangiwini Water Supply Scheme	R100,235,494.74
Imbabazane		Ntabamhlophe Phase 5 reticulation (24/2010)	R19,155,608.79
RBIG (Regional Bulk Infrastructure Grant)			
Emnambithi/Ladysmith		Driefontein upgrading of Burford water supply scheme	R 40,000,000.00
Corridor development (COGTA Grant)			
Okhahlamba		Upgrading sewer to a water borne system	R39, 000, 000. 00

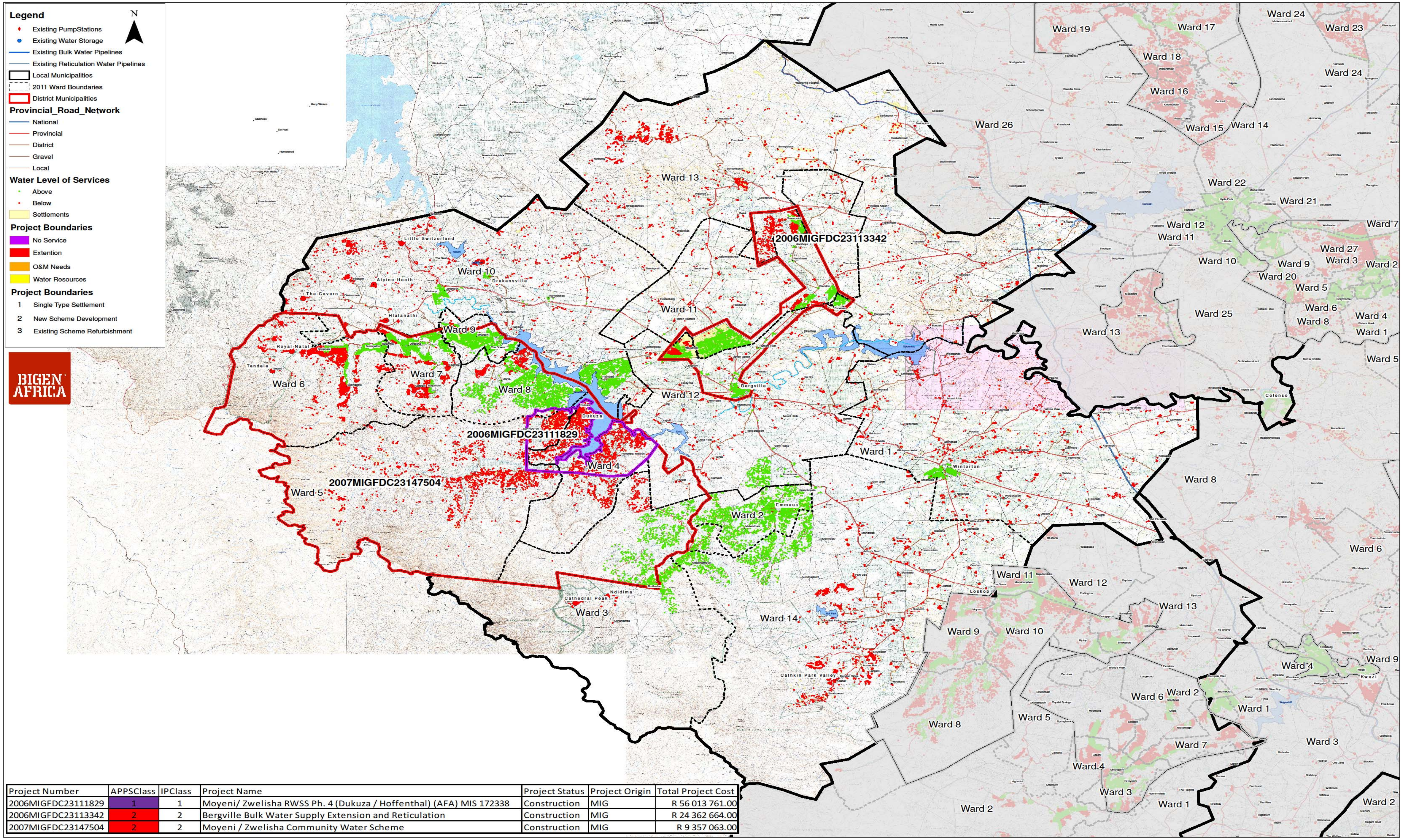
Table 28 - MIG Projects
(Source: IDP 2013)

The maps on pages 78-82 indicate the various projects in each Local Municipality, the funding agent, status of the projects and total project cost. These drawings were sourced from Bigen Africa

The GIS provided by the UTDM indicated their proposed water supply schemes. Where possible the concept designs were tied into the UTDM's planned network to avoid any duplication of infrastructure and reduce costs.

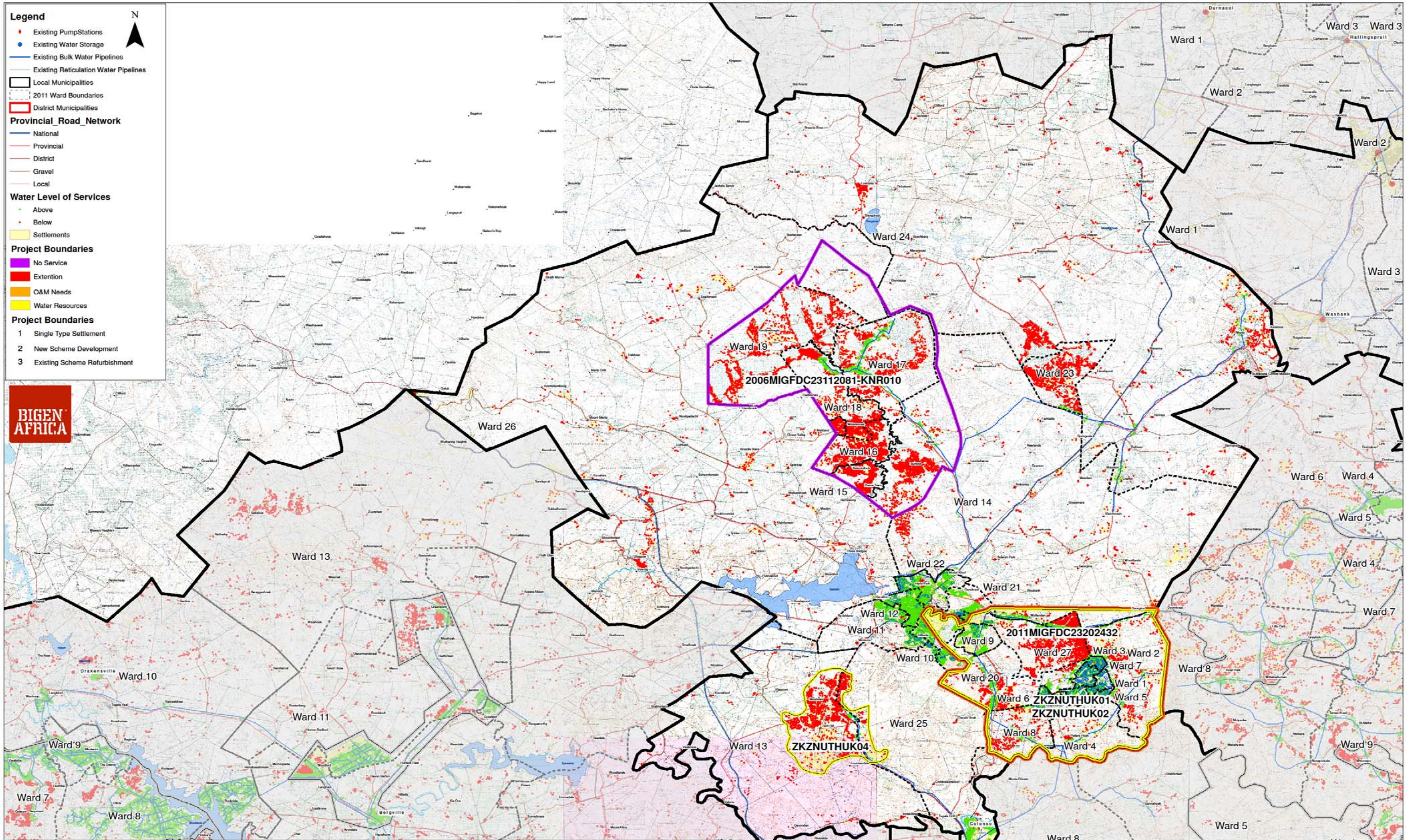
The quantification and pricing undertaken in this report is based on UAP proposals only and does not take into consideration the future infrastructure already planned by the UTDM as it is assumed that funding for these proposals have already been secured by UTDM.

UTHUKELA - OKHAHLAMBA



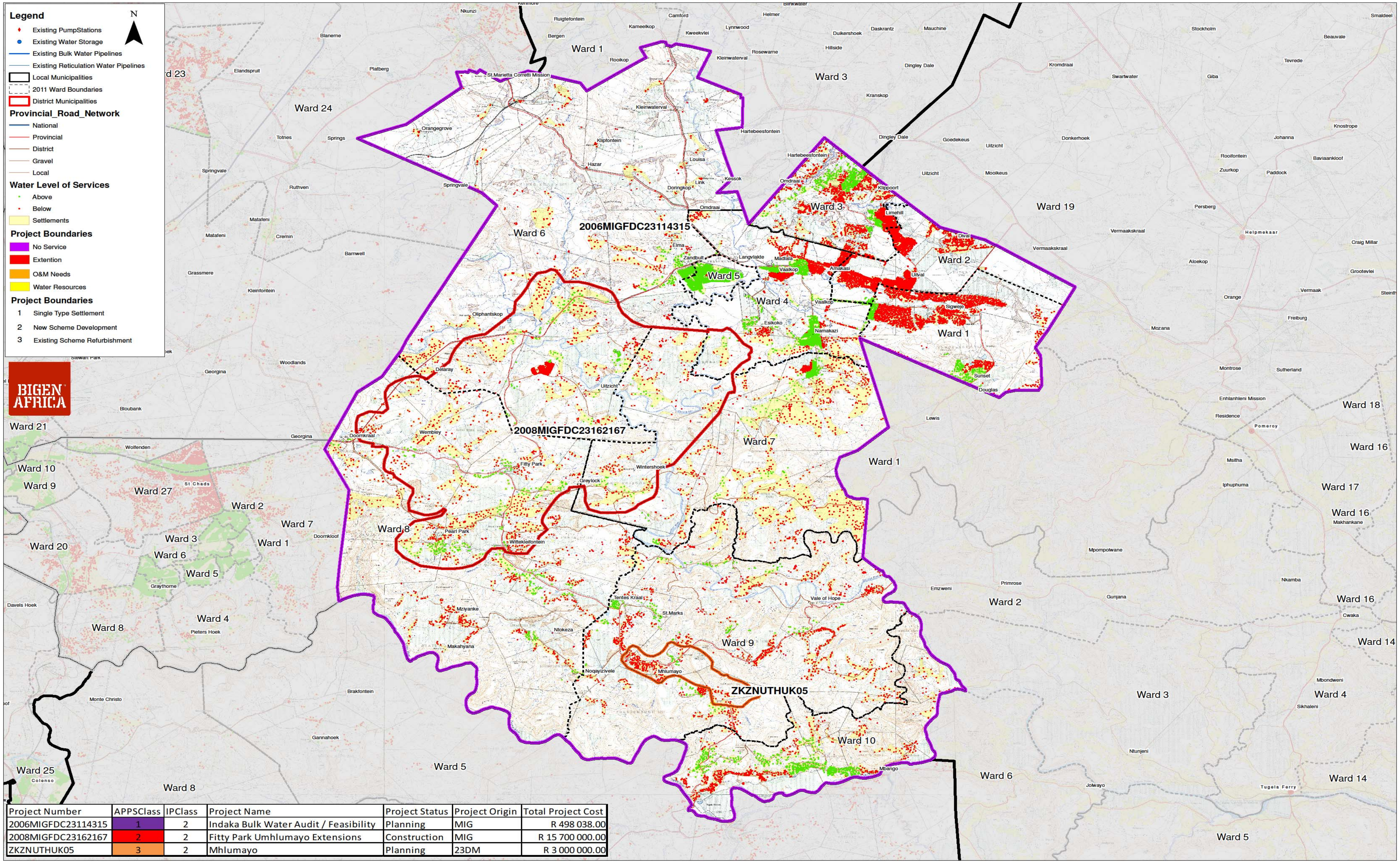
Project Number	APPSClass	IPClass	Project Name	Project Status	Project Origin	Total Project Cost
2006MIGFDC23111829	1	1	Moyeni/ Zwelisha RWSS Ph. 4 (Dukuza / Hoffenthal) (AFA) MIS 172338	Construction	MIG	R 56 013 761.00
2006MIGFDC23113342	2	2	Bergville Bulk Water Supply Extension and Reticulation	Construction	MIG	R 24 362 664.00
2007MIGFDC23147504	2	2	Moyeni / Zwelisha Community Water Scheme	Construction	MIG	R 9 357 063.00

UTHUKELA - EMNAMBITHI/LADYSMITH



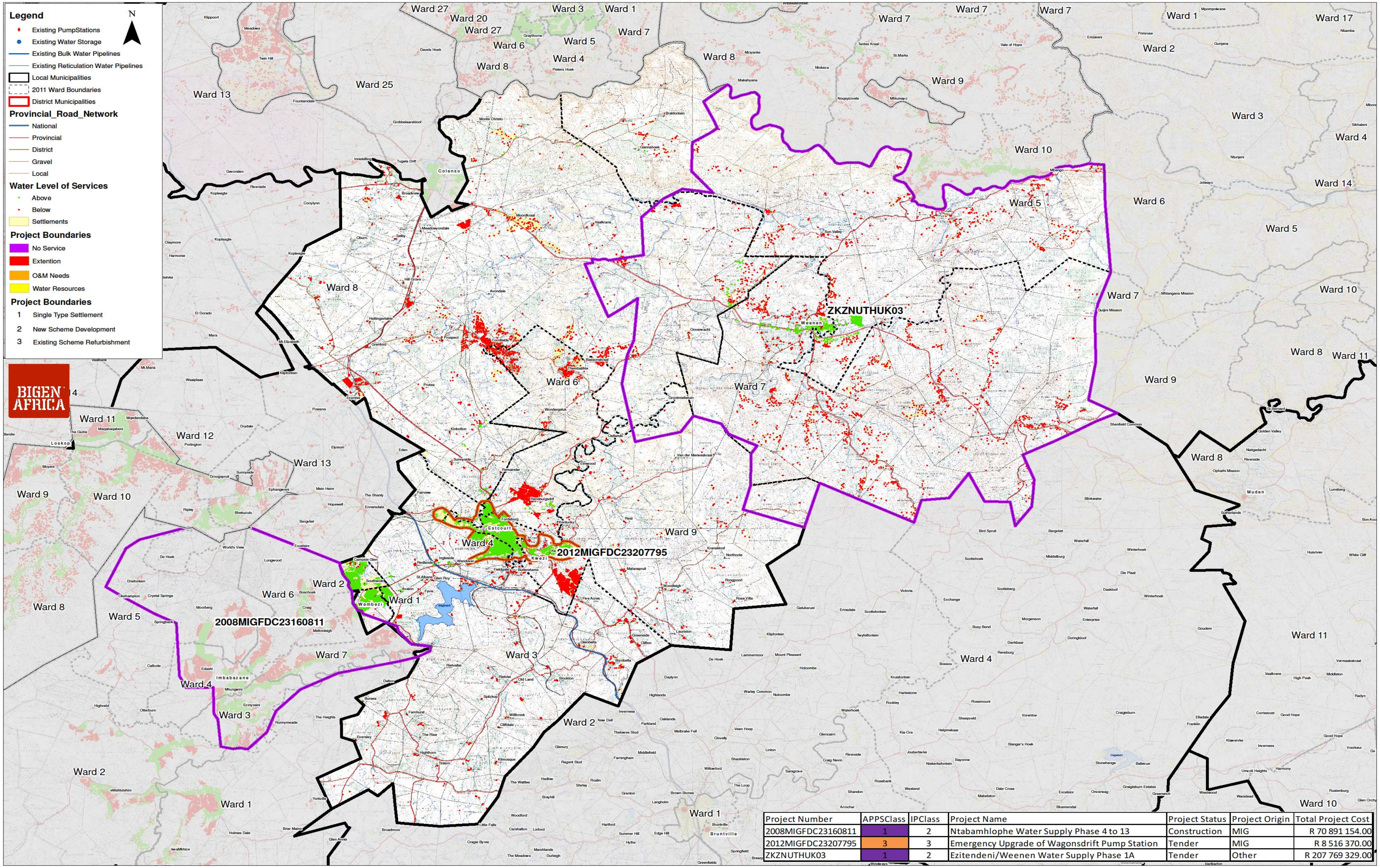
Project Number	APPSClass	IPClass	Project Name	Project Status	Project Origin	Total Project Cost
2006MIGFDC23112081-KNR010	1	2	Driefontein Complex Bulk Water Supply	Construction	MIG	R 126 101 362.00
2011MIGFDC23202432	3	2	Ezakheni / Emnambithi Bulk Water Infrastructure Upgrade Project (Planning phase)	Tender	MIG	R 5 526 000.00
ZKZNUTHUK01	3	3	Ezakheni / Emnambithi WCDM	Awaiting Funding	23DM	R 200 000 000.00
ZKZNUTHUK02	4	2	Ezakheni/ Ladysmith Bulk Upgrade	Conceptual	Other	R 1 400 000 000.00
ZKZNUTHUK04	4	2	Roosboom Reticulation	Awaiting funding	23DM	R 1 500 000.00

UTHUKELA - INDAKA



Project Number	APPSClass	IPClass	Project Name	Project Status	Project Origin	Total Project Cost
2006MIGFDC23114315	1	2	Indaka Bulk Water Audit / Feasibility	Planning	MIG	R 498 038.00
2008MIGFDC23162167	2	2	Fitty Park Umhlumayo Extensions	Construction	MIG	R 15 700 000.00
ZKZNUTHUK05	3	2	Mhlumayo	Planning	23DM	R 3 000 000.00

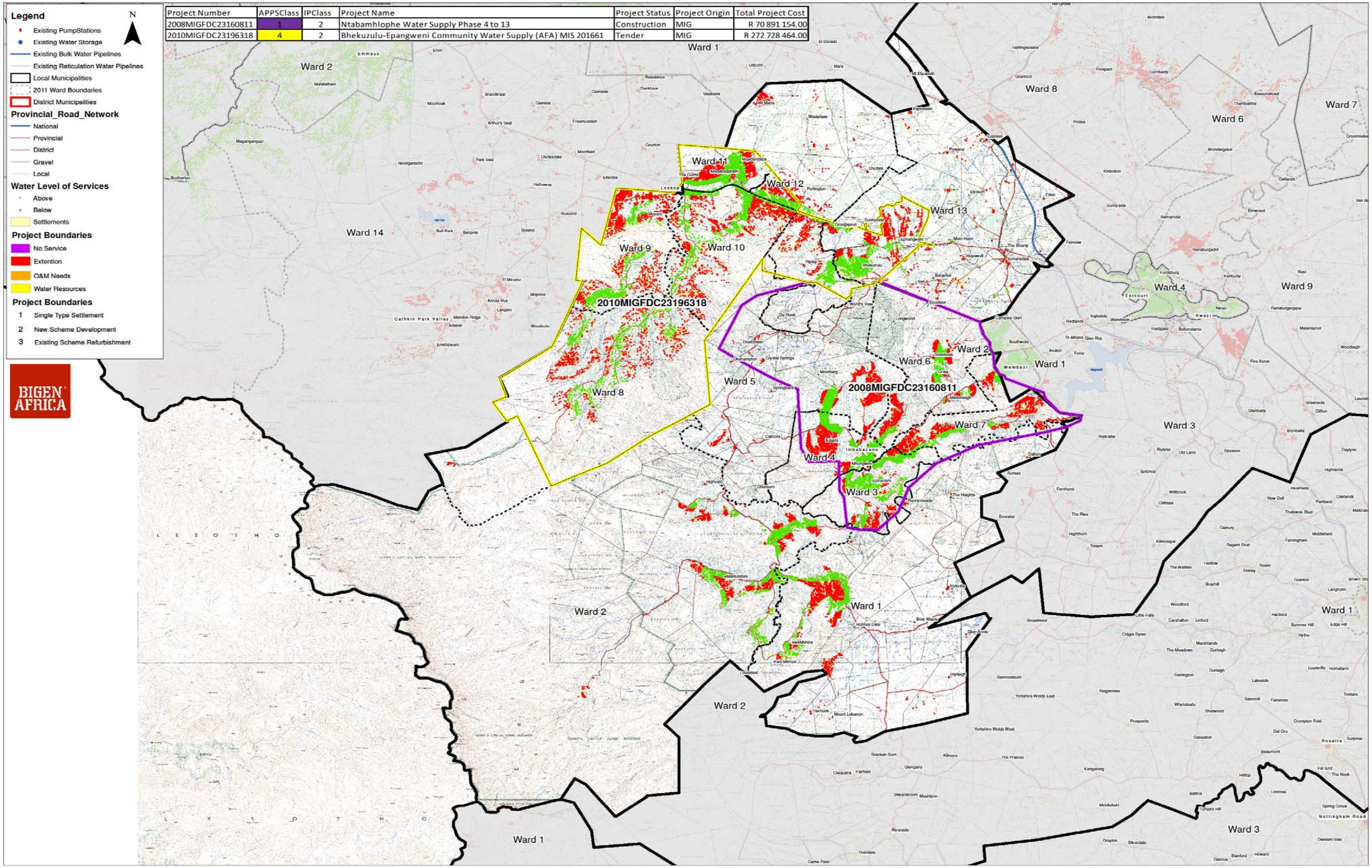
UTHUKELA - UMTSHEZI



Project Number	APPSClass	IPClass	Project Name	Project Status	Project Origin	Total Project Cost
2008MIGFDC23160811	1	2	Ntabamhlophe Water Supply Phase 4 to 13	Construction	MIG	R 70 891 154.00
2012MIGFDC23207795	3	3	Emergency Upgrade of Wagonsdrift Pump Station	Tender	MIG	R 8 516 370.00
ZKZNUTHUK03	1	2	Ezitendeni/Weenen Water Supply Phase 1A	Tender	Other	R 207 769 329.00

UTHUKELA - IMBABAZANE

Project Number	APPSClass	IPClass	Project Name	Project Status	Project Origin	Total Project Cost
2008MIGFDC23160811	1	2	Ntabamhlophe Water Supply Phase 4 to 13	Construction	MIG	R 70 891 154.00
2010MIGFDC23196318	4	2	Bhekuzulu-Epangweni Community Water Supply (AFA) MIS 201661	Tender	MIG	R 272 728 464.00



8. APPROACH TO WATER SUPPLY

8.1 Water Treatment Works Situation Analysis

Reconciliation Strategies undertaken in 2011 indicated the capacities of the WTW within the various local municipalities. These capacities were used to determine how many of the backlogs could be alleviated based on the UAP intent of delivering at least 70l/c/d of water.

The calculations indicated below were undertaken to determine if the existing WTW within the various local municipalities can meet the demand of the backlogs. In addition, these calculations provide an indication that the link to existing scheme type can be undertaken immediately as the need for elaborate infrastructure is minimal.

Okhahlamba Local Municipality

Current Population	= 132068
Consumption based on 70l/c/d	= 9.24 ML/d

Okhahlamba Local Municipality is served by Zwelisha WTW (2 ML/d), Zwelisha Phase 2 WTW (2.0 ML), Bergville WTW (2.88 ML/d), Winterton WTW (1.35 ML/d) and Boreholes (2.16 ML/d).

Total Capacity of existing water treatment works	= 10.39 ML/d

Hence the calculation above indicates that there is insufficient water treatment capacity in the Okhahlamba Local Municipality currently.

Emnambithi/Ladysmith Local Municipality

Current Population	= 237437
Consumption based on 70l/c/d	= 16.62 ML/d

Emnambithi/Ladysmith Local Municipality is served by Colenso WTW (2.64 ML/d), Ezakheni WTW (46.0 ML/d) and Ladysmith WTW (36.0 ML/d).

Total Capacity of existing water treatment works	= 84.64 ML/d

Hence the above calculation indicates that there is sufficient water treatment capacity in the Emnambithi/Ladysmith Local Municipality currently.

Indaka Local Municipality

Current Population	= 103116
Consumption based on 70l/c/d	= 7.20 ML/d

Indaka Local Municipality is served by Oliphants WTW (10.0 ML/d).

Total Capacity of existing water treatment works	= 10.0 ML/d

Hence the above calculation indicates that there is sufficient water treatment capacity in the Indaka Local Municipality currently.

Umtshezi Local Municipality

Current Population = 83153

Consumption based on 70l/c/d = 5.82 ML/d

Umtshezi Local Municipality is served by Archie Rodel WTW (12.0 ML), George Cross WWT (21.0 ML) and Weenen WTW (4.0 ML).

Total Capacity of existing water treatment works = 37.0 ML/d

Hence the above calculation indicates that there is sufficient water treatment capacity in the Umtshezi Local Municipality currently.

Imbabazane Local Municipality

Current Population = 113073

Consumption based on 70 l/c/d = 7.92 ML/d

Imbabazane Local Municipality is served by Loskop WTW (2.0 ML/d).

Total Capacity of existing water treatment works = 2.0 ML/d

Hence the above calculation indicates that there is insufficient water treatment capacity in the Imbabazane Local Municipality currently.

8.2 Design Parameters

MM PDNA undertook the conceptual design for the entire District Municipality and divided this into each Local Municipality. The following assumptions were made in undertaking the conceptual design:

- Water consumptions were based in accordance to the Table 29 below:

Description of consumer category	Household Annual Income range	Per capita cons (l/c/d)		
		Min	Ave.	Max.
Very High Income; villas, large detached house, large luxury flats	>R1 228 000	320	410	500
Upper middle income: detached houses, large flats	153 601 – 1 228 000	240	295	350
Average Middle Income: 2 - 3 bedroom houses or flats with 1 or 2 WC, kitchen, and one bathroom, shower	38 401 – 153 600	180	228	275
Low middle Income: Small houses or flats with WC, one kitchen, one bathroom	9 601– 38 400	120	170	220
Low income: flatlets, bedsits with kitchen & bathroom, informal household	1- 9600	60	100	140
No income & informal supplies with yard connections		60	70	100
Informal with no formal connection		30	70	70
Informal below 25 l/c/d		0	70	70

Table 29 - Water Consumptions

- Each household has an average of 6 people
- Some of the existing boreholes are functional.
- The existing water reticulation schemes are operational.
- Some of the existing water reticulation schemes have spare capacity.
- Existing water treatment works have the potential to be upgraded or rehabilitated.
- Schemes have some form of power supply.
- General pipe size range is from 25 mm to 150 mm diameter.
- Peak factor - 1.5
- Water losses were considered to be 35%
- Where there is an existing bulk line, connections to the bulk were kept to a minimum
- Reticulation mains were placed in the road reserve for maintenance purposes
- District and provincial road crossings were kept to a minimum

8.3 Scheme Types

MM PDNA assessed some of the existing water supply options that the UTDM currently implements and applied the same scheme types to supply the un-serviced polygons. The following schemes were adopted by MM PDNA to determine the scheme type applicable to the different settlements and their associated. These costs were provided by Umgeni Water.

- Tie into existing schemes
- Existing boreholes and standpipes that are non-functional to be rehabilitated.
- Existing boreholes with reticulation to be rehabilitated.
- Boreholes mechanically operated for settlements with a low population.
- Boreholes electronically operated for settlements with a high population.
- Package Plants for settlements which are densely populated.
- From existing scheme pumped to new reservoir and reticulated.
- Where the existing borehole schemes are indicated but the settlement households are still indicated as un-serviced. It was assumed that there was an issue with the existing boreholes; therefore it was linked to the contiguous water supply schemes. Figure 17 below indicates this principle.

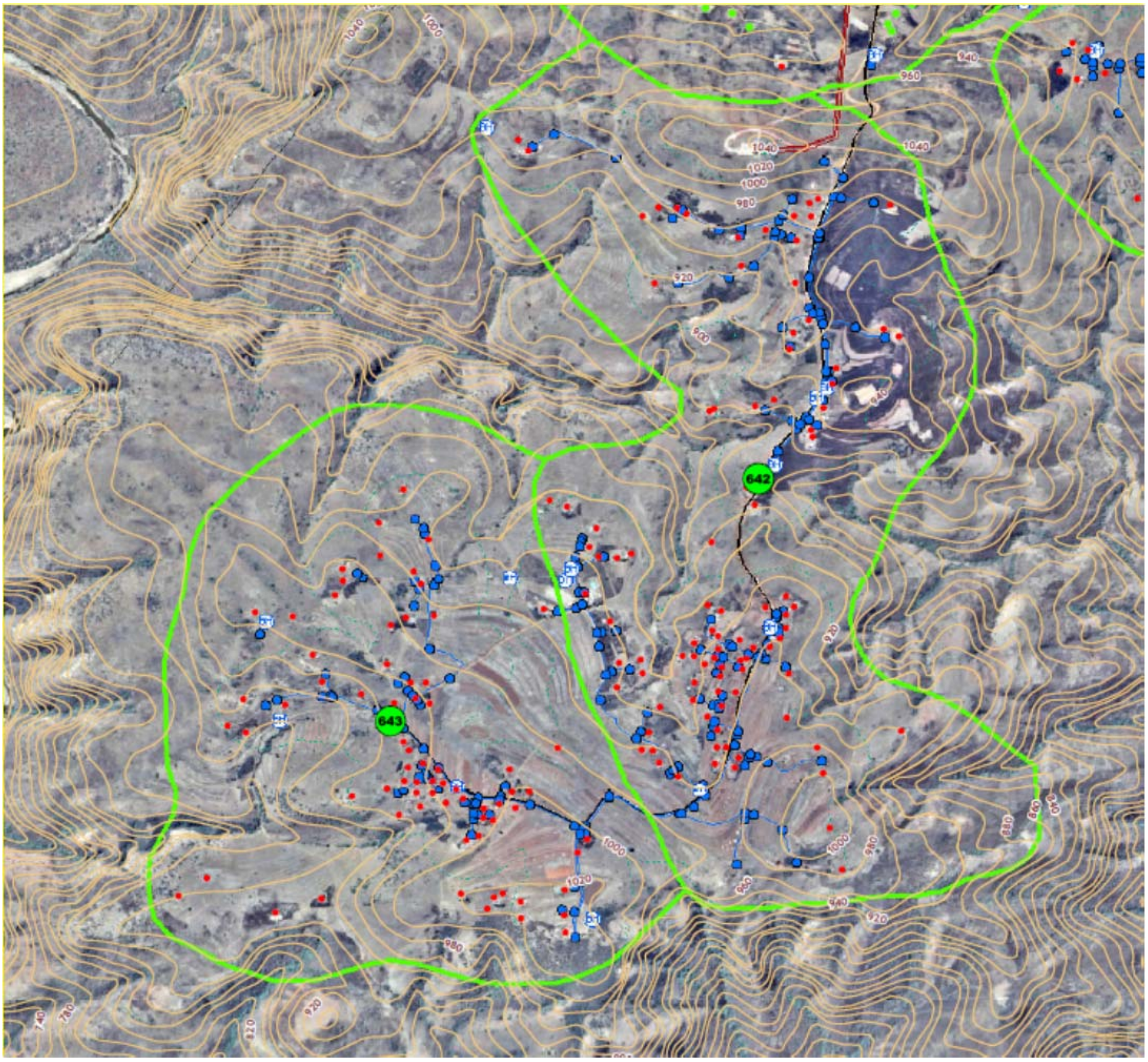


Figure 17 - Existing Borehole Schemes not in operation

8.3.1 Link to existing scheme

Areas currently without supply that are located adjacent to existing water mains could be supplied by extending the existing reticulation to the adjacent, currently unserviced area.

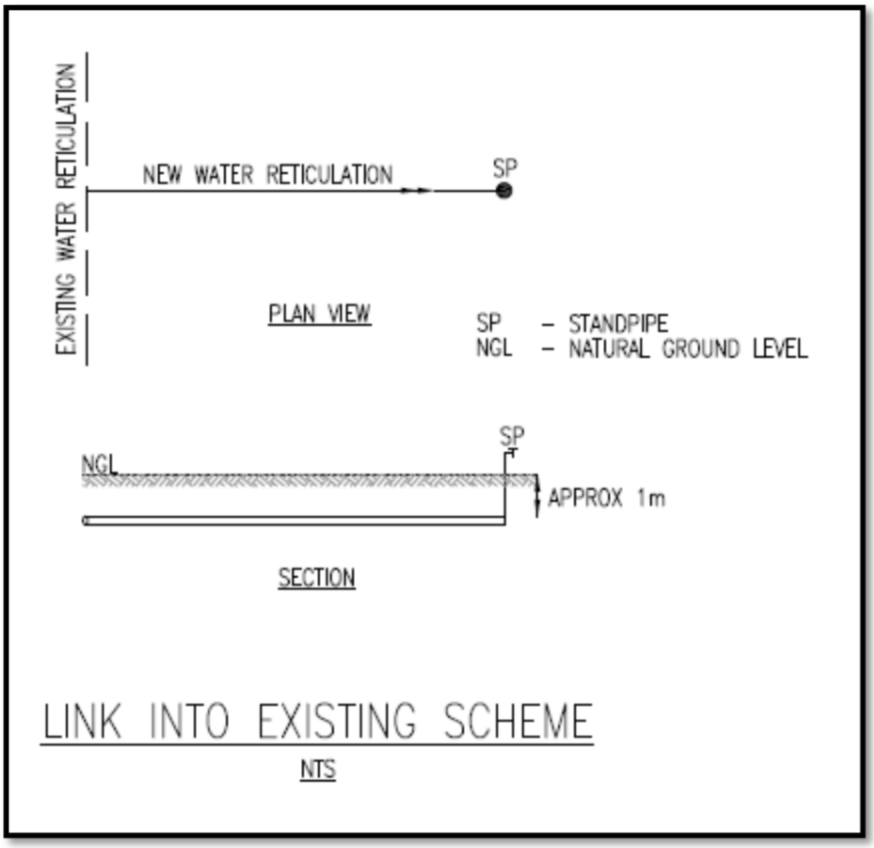
- During the assessment of the reticulation needs for the polygons, it was noted that several of the schemes contain boreholes which are not currently supplying the surrounding households. It was therefore assumed that these particular boreholes are non-functional and as such MM PDNA provided alternative supply sources to these schemes.

  The GIS information indicated a bulk supply line indicated contiguous to the community which was used to supply the area.

- In some cases the GIS information indicates that there is an existing bulk line, however there are un-serviced households contiguous to the bulk line. It was assumed that they are un-serviced due to the households being at a higher elevation.

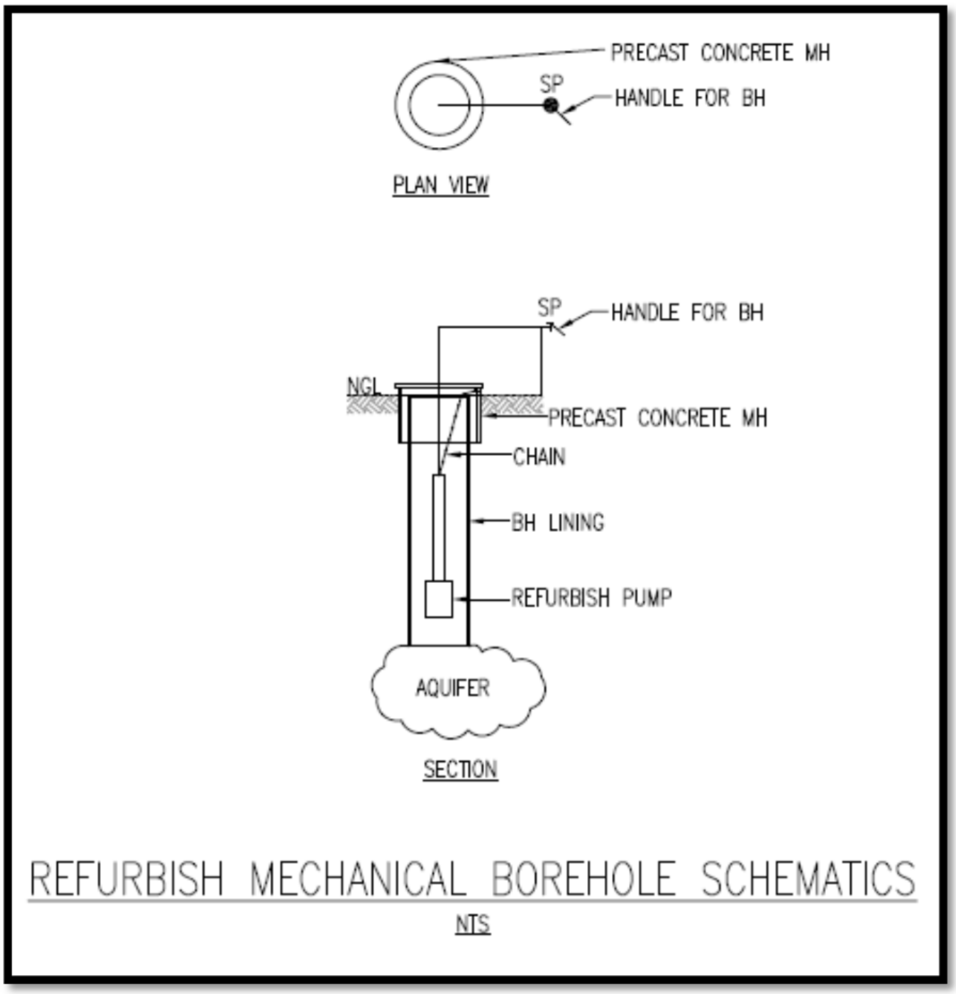
  These households were serviced by undertaking a pumping main from the existing bulk to a new reservoir at a higher elevation where it can be gravity fed to the households. This was deemed to be the cost effective option.

  In areas where the static head exceeds 100m, break pressure tanks should be constructed to reduce the pressure and also create additional storage.



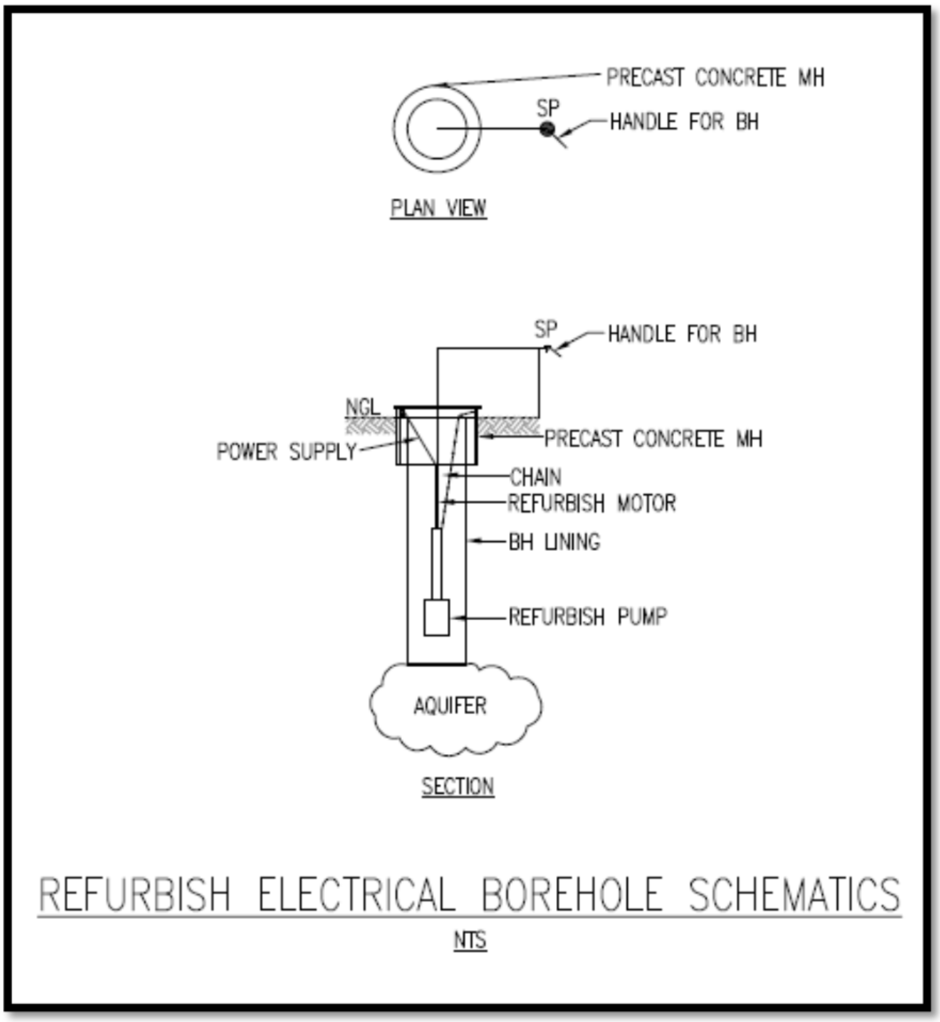
8.3.2 Refurbishment of Mechanical Boreholes

The existing mechanical boreholes that previously supplied water to a community are now defunct as the pumps are no longer functioning. Hence a replacement pump needs to be installed to ensure the continued delivery of water.



8.3.3 Refurbishment of Electrical Boreholes

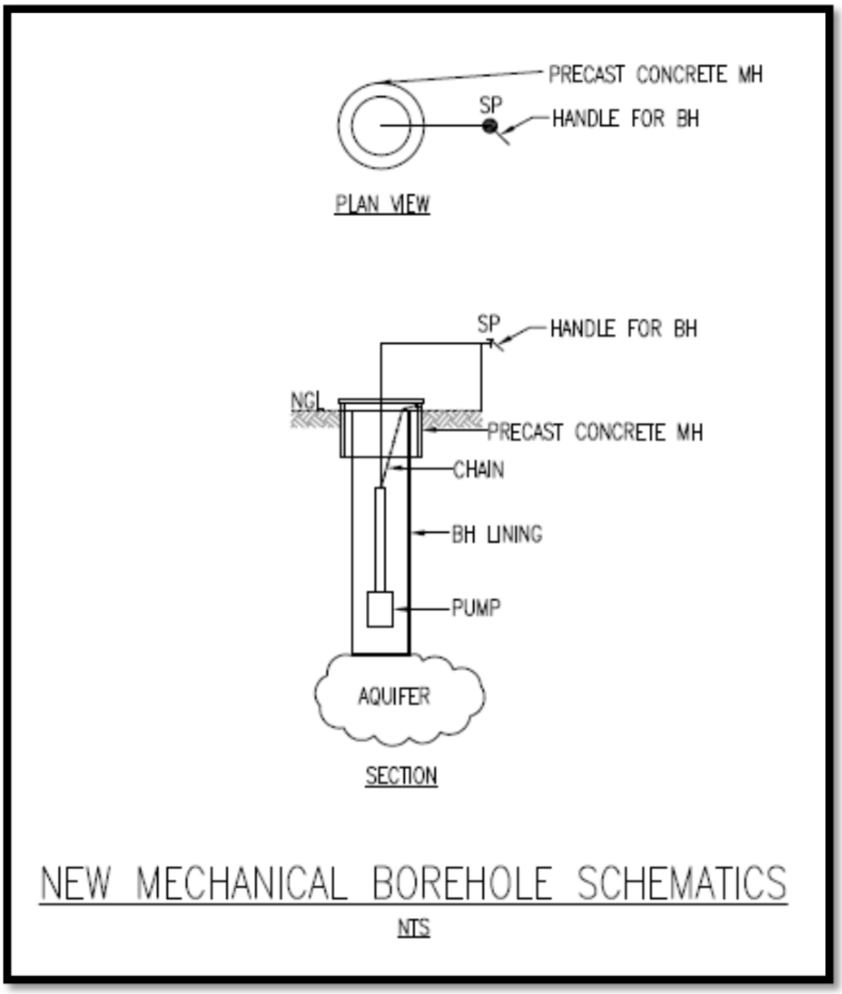
The existing electrical boreholes that previously supplied water to a community are now defunct as the pumps or motors are no longer functioning. Hence replacement pumps or motors need to be installed to ensure the continued delivery of water.



8.3.4 New Mechanical Boreholes

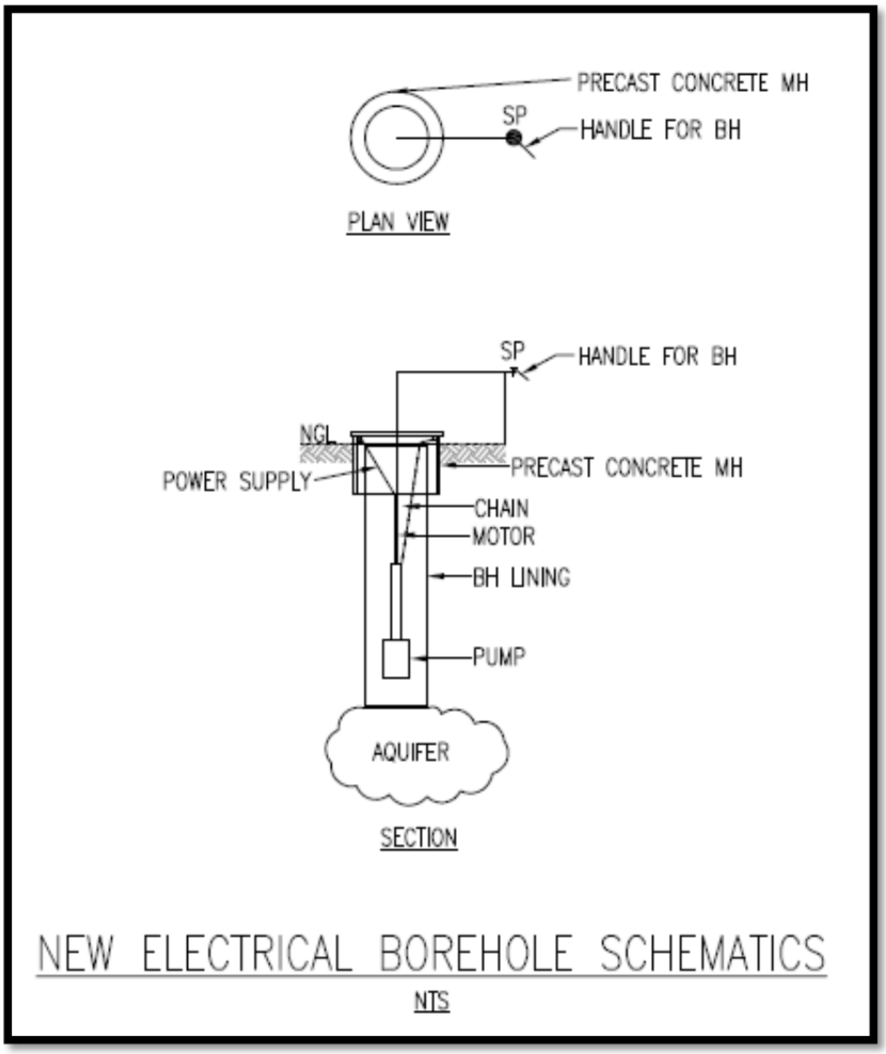
Mechanical boreholes are installed in remote rural areas where there is no available water reticulation and electrical supply.

The view adopted by MM PDNA was, where the population was in the region of 20-30 people mechanical boreholes would be the most cost effective supply of water. The alternative considered to a mechanical borehole system was the installation of a wind powered borehole system.



8.3.5 New Electrical Boreholes

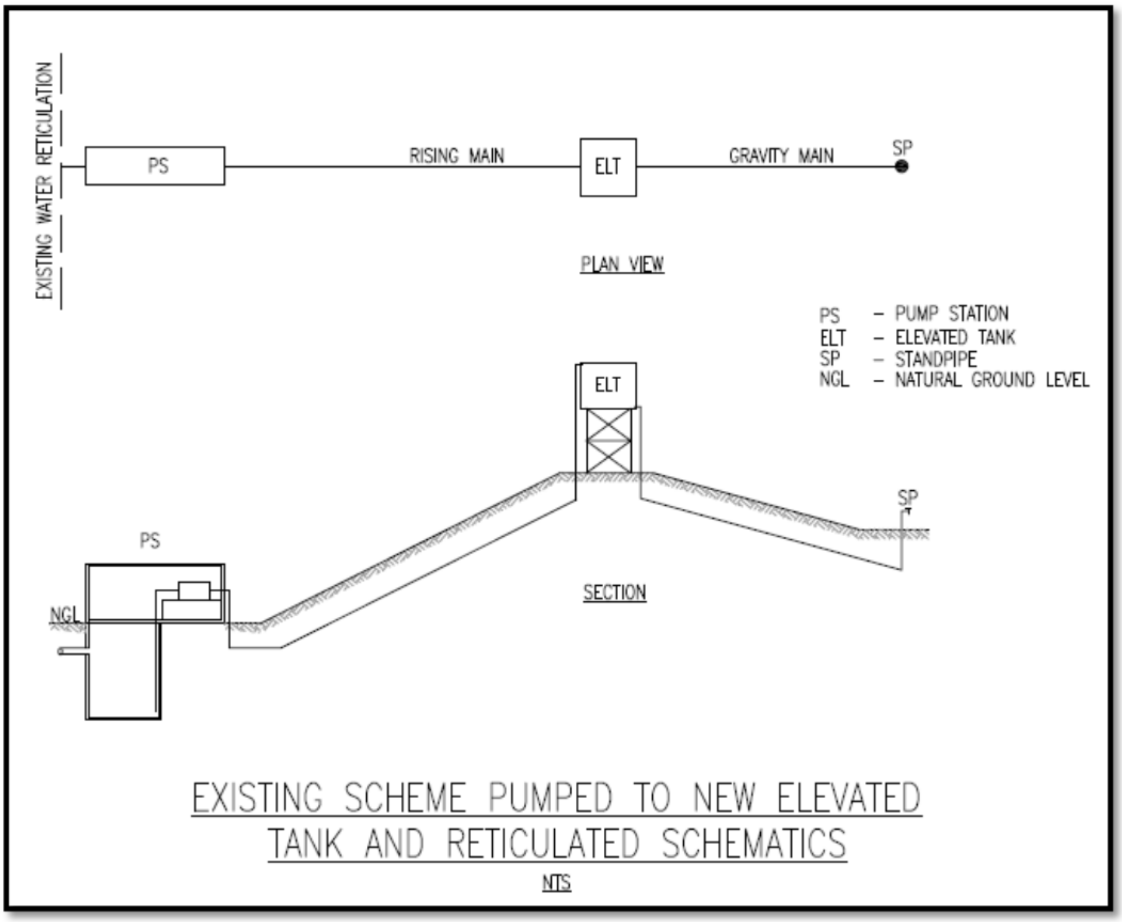
Electrical boreholes are installed in remote rural areas where there is no available water reticulation, but where electrical supply is available.



8.3.6 Existing Scheme Pumped to New Elevated Tank and Reticulated

There are areas at elevations higher than the existing reticulation without supply, which cannot be supplied by the existing reticulation due to the height difference.

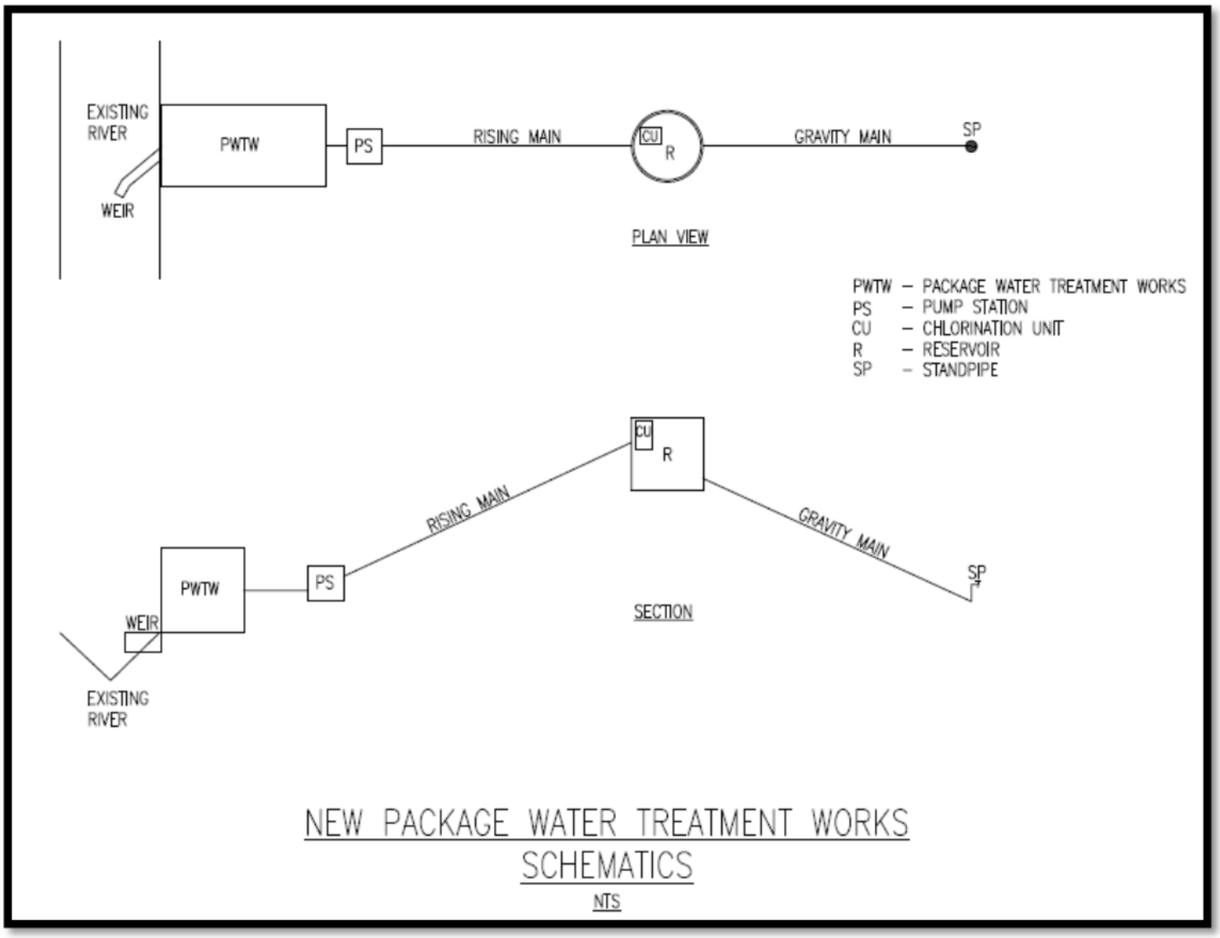
This alternative proposes to supply the houses at these higher elevations by obtaining water from the existing mains and installing a wet well and a pump station as well as an elevated reservoir.



8.3.7 New Package Water Treatment Works

Areas which are located close to a river source can be supplied by a containerized package treatment plant, which could abstract water from the river.

This alternative proposes to abstract water from the river through the package plant which has flocculation units, clarification units and filtration units. The water would then be pumped via a pump station to the storage reservoir which will require a chlorination unit to be installed.


EXISTING RIVER
WEIR
PWTW
PS
RISING MAIN
CU
R
GRAVITY MAIN
SP
PLAN VIEW
PWTW – PACKAGE WATER TREATMENT WORKS
PS – PUMP STATION
CU – CHLORINATION UNIT
R – RESERVOIR
SP – STANDPIPE
CU
R
RISING MAIN
GRAVITY MAIN
PWTW
PS
SP
WEIR
SECTION
EXISTING RIVER
NEW PACKAGE WATER TREATMENT WORKS
SCHEMATICS
NTS

8.4 Description and Mapping of Supply Schemes

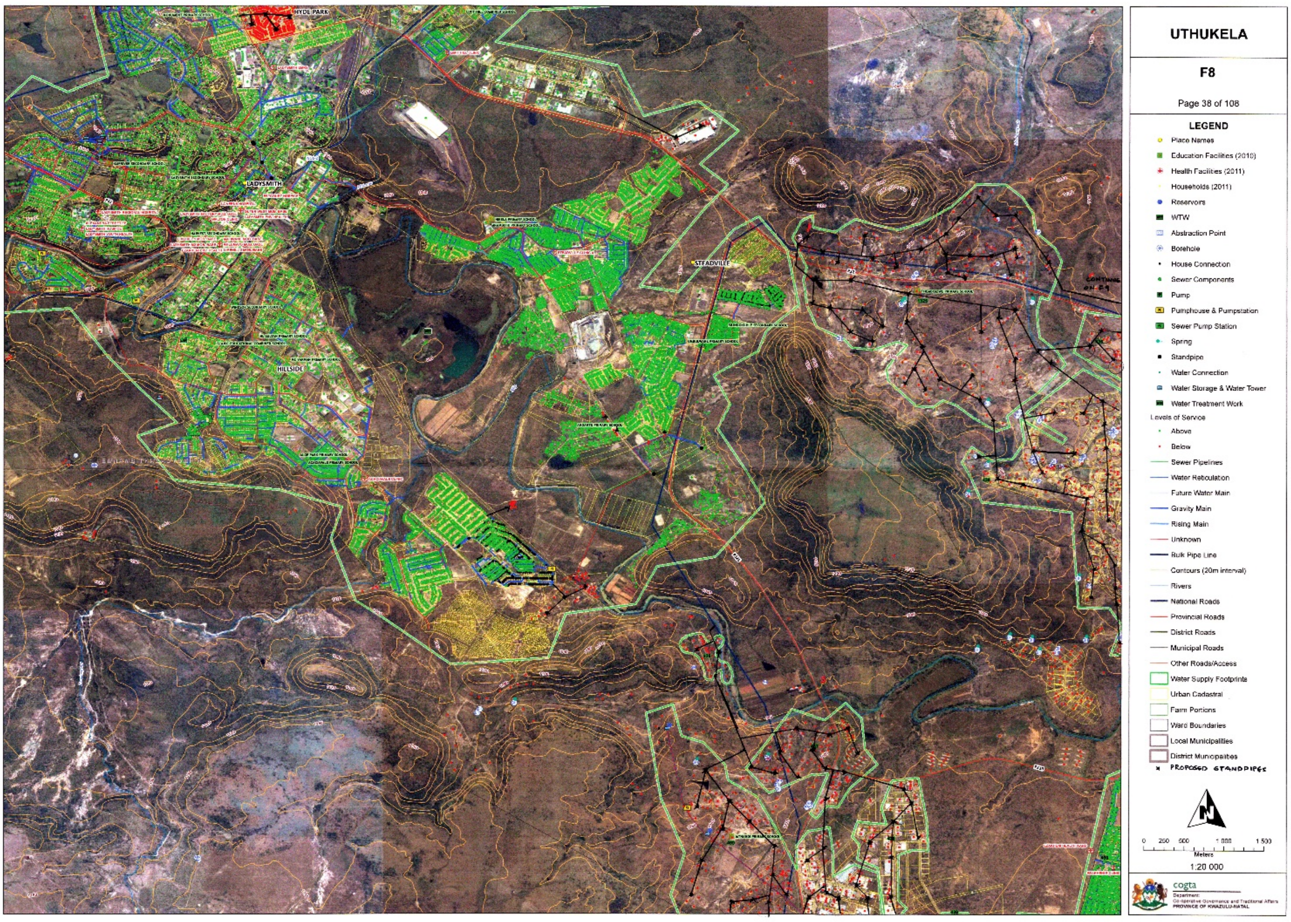
The Uthukela District Municipality was plotted in a map series produced at a scale of 1:20 000. Existing and proposed infrastructure, together with the water supply footprints and contour information (20m intervals) were overlaid onto aerial photography and both exported to pdf and plotted.

Map 7: Example of map series sheet

These maps were used, together with the population statistics already calculated, by the engineers at MM PDNA, who designed conceptual water supply schemes directly onto the hard copy maps. These maps were returned to MHP GeoSpace, and the concept water pipelines and other infrastructure (standpipes, boreholes, reservoirs etc.) were digitised into the GIS.

New feature classes were added to the geodatabase and lookup tables assigned to fields within the feature classes. This ensured consistency throughout the data capture process, as it meant that there would be no difference in the type of features captured by different users. The digitised infrastructure was checked to ensure that there was consistency between and across the different map sheets, as well as between the adjacent district municipalities in our project area, namely Amajuba to the west and Umkhanyakude to the east. Each individual map sheet was also checked to ensure that all data had been captured.

Where the conceptual water infrastructure was designed and captured (i.e. where there was no existing supply infrastructure) the settlement (water demand) polygon was assigned a unique identifier. This identifier was captured to a separate data set (costed water supply areas) which could later be linked back to the costing model used by the engineers.



Map 8 – Example of data captured from engineers drawings

8.5 Cost Estimates for Proposed Infrastructure

The rates provided by Umgeni Water are shown on the tables below:

Reservoir

0.25	ML	R 1 381 197
0.5	ML	R 2 243 761
0.75	ML	R 2 980 166
1	ML	R 3 645 000
1.25	ML	R 4 261 226
1.5	ML	R 4 841 294
1.75	ML	R 5 392 922
2	ML	R 5 921 320
2.25	ML	R 6 430 212
2.5	ML	R 6 922 382
2.75	ML	R 7 399 978
3	ML	R 7 864 705
3.25	ML	R 8 317 942
3.5	ML	R 8 760 828
3.75	ML	R 9 194 316
4	ML	R 9 619 213
4.25	ML	R 10 036 211
4.5	ML	R 10 445 910
4.75	ML	R 10 848 834
5	ML	R 11 245 442
5.25	ML	R 11 636 143
5.5	ML	R 12 021 299
5.75	ML	R 12 401 237
6	ML	R 12 776 250
6.25	ML	R 13 146 603
6.5	ML	R 13 512 537
6.75	ML	R 13 874 271
7	ML	R 14 232 007
7.25	ML	R 14 585 930
7.5	ML	R 14 936 210
7.75	ML	R 15 283 004
8	ML	R 15 626 457
8.25	ML	R 15 966 705
8.5	ML	R 16 303 873
8.75	ML	R 16 638 079
9	ML	R 16 969 431
9.25	ML	R 17 298 034
9.5	ML	R 17 623 983
9.75	ML	R 17 947 368
10	ML	R 18 268 275
10.25	ML	R 18 586 783

Pump Station (Civil, Mech and Elec)

0.25	MW	R 11 000 000
0.5	MW	R 18 000 000
0.75	MW	R 25 000 000
1	MW	R 33 000 000
1.25	MW	R 44 000 000
1.5	MW	R 55 000 000
1.75	MW	R 66 000 000
2	MW	R 77 000 000

Pump Station Expansion (Mech and Elec)

0.25	MW	R 3 750 000
0.5	MW	R 7 500 000
0.75	MW	R 11 250 000
1	MW	R 15 000 000
1.25	MW	R 18 750 000
1.5	MW	R 22 500 000
1.75	MW	R 26 250 000
2	MW	R 30 000 000

Water Works

0-50	ML/d	R 4 000 000
50-100	ML/d	R 2 500 000
100-1000	ML/d	R 2 000 000

Water Works Augmentation

0-50	ML/d	R 1 800 000
50-200	ML/d	R 1 500 000

Pipes Steel (mm Ø)

150	mm	R 550
200	mm	R 600
300	mm	R 700
350	mm	R 800
400	mm	R 900
450	mm	R 1 300
500	mm	R 1 650
600	mm	R 1 980
700	mm	R 2 500
800	mm	R 3 200
850	mm	R 3 350
1000	mm	R 3 971

10.5	ML	R 18 902 970	1100	mm	R 4 075
10.75	ML	R 19 216 906	1200	mm	R 4 500
11	ML	R 19 528 659	1300	mm	R 6 065
11.25	ML	R 19 838 293	1400	mm	R 6 900
11.5	ML	R 20 145 870	1600	mm	R 8 500
11.75	ML	R 20 451 447	1800	mm	R 9 563
12	ML	R 20 755 080			
12.25	ML	R 20 056 820	**Pipes Plastic (mm Ø)**		
12.5	ML	R 21 356 719	75	mm	R 100
12.75	ML	R 21 654 824	100	mm	R 140
13	ML	R 21 951 180	200	mm	R 250
13.25	ML	R 22 245 832	300	mm	R 350
13.5	ML	R 22 538 820			
13.75	ML	R 22 830 185	**Fittings and Auxiliaries**		
14	ML	R 23 119 964			
14.25	ML	R 23 408 196	**Pipes Installation (mm Ø)**		
14.5	ML	R 23 694 914	150	mm	R 858
14.75	ML	R 23 980 153	200	mm	R 936
15	ML	R 24 263 945	300	mm	R 1 091
15.25	ML	R 24 546 322	350	mm	R 1 247
15.5	ML	R 24 827 313	400	mm	R 1 403
15.75	ML	R 25 106 948	450	mm	R 2 027
16	ML	R 25 385 254	500	mm	R 2 573
16.25	ML	R 25 662 259	600	mm	R 3 087
16.5	ML	R 25 937 989	700	mm	R 3 898
16.75	ML	R 26 212 467	800	mm	R 4 990
17	ML	R 26 485 720	850	mm	R 5 224
17.25	ML	R 26 757 769	1000	mm	R 6 192
17.5	ML	R 27 028 638	1100	mm	R 6 354
17.75	ML	R 27 298 349	1200	mm	R 7 017
18	ML	R 27 566 923	1300	mm	R 9 457
18.25	ML	R 27 834 379	1400	mm	R 10 759
18.5	ML	R 28 100 739	1600	mm	R 13 254
18.75	ML	R 28 366 021	1800	mm	R 14 910
19	ML	R 28 630 244			
19.25	ML	R 28 893 426			
19.5	ML	R 29 155 585			
19.75	ML	R 29 416 737			
20	ML	R 29 676 900			
20.25	ML	R 29 936 088			
20.5	ML	R 30 194 319			
20.75	ML	R 30 451 606			
21	ML	R 30 707 965			
21.25	ML	R 30 963 410			
21.5	ML	R 31 217 955			

21.75	ML	R 31 471 614
22	ML	R 31 724 399
22.25	ML	R 31 976 325
22.5	ML	R 32 227 402
22.75	ML	R 32 477 644
23	ML	R 32 727 062
23.25	ML	R 32 975 668
23.5	ML	R 33 223 474
23.75	ML	R 33 470 489
24	ML	R 33 716 726
24.25	ML	R 33 962 195
24.5	ML	R 34 206 906
24.75	ML	R 34 450 869
25	ML	R 34 694 093
25.25	ML	R 34 936 589
25.5	ML	R 35 178 366
25.75	ML	R 35 419 432
26	ML	R 35 659 798
26.25	ML	R 35 899 471
26.5	ML	R 36 138 460
26.75	ML	R 36 376 774
27	ML	R 36 614 421
27.25	ML	R 36 851 408
27.5	ML	R 37 087 744
27.75	ML	R 37 323 436
28	ML	R 37 558 493
28.25	ML	R 37 792 920
28.5	ML	R 38 026 726
28.75	ML	R 38 259 917
29	ML	R 38 492 501
29.25	ML	R 38 724 484
29.5	ML	R 38 955 873
29.75	ML	R 39 186 675
30	ML	R 39 416 895

8.5.1 Proposed Short Term Supply Schemes

The tables below show the cost estimate for short term schemes which tie into the existing reticulation.

Scheme Name	Cost
C10-1	R 9 738 790

C10 – Refers to the drawing number (i.e. drawings on the attached CD)
1 – Refers to the scheme number on the associated drawing
Each scheme number has an associated cost which is also captured on the GIS database.

The cost estimates are based on providing a UAP service only. The upgrading of existing works or rehabilitation of existing water infrastructure have not been included in the cost estimates. The estimates exclude all operational and maintenance costs.

The cost estimates cover the price of undertaking the construction of the water scheme as well as professional fees for the following: geotechnical engineering fees, environmental fees and engineering fees.

In some cases the GIS picked up single scattered houses which are shown to be un-serviced within a polygon which is serviced. It is assumed that these houses came about after the construction of the water supply in that area. For the purpose of the conceptual design and cost estimates, it was proposed that these houses be supplied with standpipes by connecting into the existing water reticulation infrastructure.

8.5.1.1 Okhahlamba Local Municipality

Scheme Name	Cost
Link to existing	
F7-4	R 144 489 939
H2-1	R 265 678 519
H3-1	R 130 269 879
F2-7	R 9 317 837
F5-1	R 35 466 285
F5-2	R 24 345 126
F7-5	R 6 011 686
G2-1	R 93 058 191
G3-1	R 17 639 792
H4-5	R 24 167 640
H5-4	R 49 507 062
H6-2	R 65 806 008
I4-1	R 449 187 445
TOTAL	R 1 314 945 409

8.5.1.2 Ladysmith / Emnambithi Local Municipality

Scheme Name	Cost
Link to existing	
C10-1	R 9 738 790
D7-1	R 504 851 853
D9-1	R 96 759 563
D9-2	R 4 840 430
D9-3	R 3 465 845
D10-1	R 51 483 055
E8-2	R 2 855 860
E9-1	R 26 036 195
E10-1	R 1 816 344
F8-1	R 5 267 101
F8-2	R 63 516 059
F8-3	R 262 894 671
F9-1	R 27 178 750
F9-2	R 8 981 339
G9-1	R 36 043 391
TOTAL	**R 1 105 729 245**

8.5.1.3 Indaka Local Municipality

Scheme Name	Cost
Link to existing	
D10-5	R 28 324 274
D11-2	R 42 695 940
E10-1	R 31 160 756
E10-2	R 41 859 533
E10-3	R 12 495 107
E11-1	R 52 954 850
E11-2	R 14 143 179
E11-3	R 62 134 436
E12-1	R 16 366 817
F10-1	R 39 086 061
F10-2	R 36 550 228
F10-3	R 25 039 566
F10-4	R 32 562 503
F10-5	R 42 466 660
F11-1	R 50 115 618
F11-2	R 32 583 726
F11-3	R 44 319 600
F11-4	R 65 336 229
G10-1	R 64 441 319
G10-2	R 21 394 058

G11-1	R 101 562 142
G11-2	R 45 520 767
TOTAL	**R 903 113 369**

8.5.1.4 Umtshezi Local Municipality

Link to existing	
I10-1	R 135 664 196
I11-1	R 107 720 839
J9-7	R 77 784 414
H8-1	R 11 860 819
H8-2	R 35 424 828
H8-3	R 715 246
H10-1	R 1 403 968
H10-2	R 16 006 016
H10-3	R 26 631 775
H11-1	R 3 676 322
I8-4	R 3 677 751
I8-5	R 77 372 312
I10-2	R 16 351 092
I10-3	R 16 631 727
I11-2	R 6 571 527
I11-3	R 14 018 586
I12-1	R 1 610 156
J8-3	R 997 311
J8-6	R 13 309 851
J8-7	R 26 349 710
J8-8	R 1 814 914
J8-9	R 1 680 315
J9-4	R 1 058 893
J9-5	R 783 976
J9-6	R 2 503 636
J9-8	R 3 465 845
K8-4	R 20 683 892
TOTAL	**R 625 769 917**

8.5.1.5 Imbabazane Local Municipality

Scheme Name	Cost
Link to existing	
I6-4	R 182 816 918
J6-1	R 24 557 032
J6-2	R 33 033 600
J6-3	R 4 992 184
J6-4	R 25 517 812

J6-5	R 48 772 594
J7-1	R 18 855 365
J7-2	R 29 940 785
J7-3	R 17 654 088
K6-1	R 10 984 493
K6-2	R 20 908 664
K7-1	R 119 153 746
L6-1	R 15 205 568
L6-2	R 6 233 599
L6-3	R 4 501 072
L7-2	R 2 785 701
L7-3	R 4 031 404
L7-4	R 1 542 856
L7-5	R 13 919 726
Total	**R 585 407 208**

Summary of short term supply

Municipality	Total Cost
Okhahlamba	R 540 438 337
Ladysmith / Emnambithi	R 1 105 729 245
Indaka	R 903 113 369
Umtshezi	R 625 769 917
Imbabazane	R 585 407 208
TOTAL	**R 3 760 458 075**

8.5.2 Proposed Long Term Supply Schemes

The costing of the proposed infrastructure was based on information/rates provided by Umgeni Water.

8.5.2.1 Okhahlamba Local Municipality

Scheme Name	Cost	Total
Small Package Plant		**R 219 327 390**
E4-1	R 96 107 377	
H4-1	R 123 220 013	
Existing Borehole electronically operated with storage		**R 64 837 505**
G2-2	R 64 837 505	
New Borehole mechanically operated		**R 17 643 780**
F2-5	R 2 940 630	
F2-6	R 2 940 630	
F4-1	R 2 940 630	
F4-4	R 2 940 630	
G5-1	R 2 940 630	
G5-2	R 2 940 630	
New Borehole electronically operated		**R 270 701 331**
E4-2	R 3 562 052	
E4-3	R 3 699 511	
E4-4	R 3 287 135	
E4-5	R 6 872 492	
E5-1	R 3 426 023	
E5-2	R 5 076 954	
E5-3	R 4 320 933	
E5-4	R 3 355 865	
E5-5	R 3 424 594	
E5-6	R 6 660 586	
E5-7	R 7 138 831	
E6-1	R 3 630 781	
E6-2	R 4 113 316	
E6-3	R 8 042 318	
E6-4	R 6 457 257	
F1-1	R 11 762 274	
F2-1	R 5 078 384	
F2-2	R 3 975 857	
F2-3	R 3 424 594	
F2-4	R 5 832 976	
F3-1	R 4 183 474	
F4-2	R 3 699 511	
F4-3	R 3 699 511	

F6-1	R 3 354 435	
F6-2	R 5 696 947	
F7-1	R 3 148 247	
F7-2	R 3 148 247	
F7-3	R 3 285 706	
G1-1	R 3 357 294	
G1-2	R 16 855 385	
G1-3	R 10 241 654	
G4-1	R 2 025 391	
G5-3	R 3 216 976	
G5-4	R 3 149 677	
G5-5	R 3 080 948	
G6-1	R 3 285 706	
G6-2	R 31 816 774	
G7-1	R 3 216 976	
H4-2	R 3 079 518	
H4-3	R 3 285 706	
H4-4	R 10 991 957	
H5-1	R 3 630 781	
H5-2	R 3 354 435	
H5-3	R 3 630 781	
H6-1	R 3 493 323	
H7-1	R 3 287 135	
H7-2	R 3 216 976	
I5-1	R 5 830 117	
I6-1	R 3 285 706	
I6-2	R 6 517 409	
I6-3	R 3 491 893	
TOTAL		**R 572 510 006**

Cost per capita = R 13 772

8.5.2.2 Ladysmith / Emnambithi Local Municipality

Scheme Name	Cost	Total
New Borehole electronically operated		**R 142 064 754**
A8-1	R 3 768 240	
B7-1	R 13 267 719	
B7-2	R 5 970 434	
B7-3	R 4 869 337	
B9-1	R 3 768 240	
B9-2	R 10 649 740	
B9-3	R 3 148 247	
B9-4	R 3 907 128	
B9-5	R 3 216 976	

B9-6	R 3 216 976	
C6-1	R 7 902 001	
C6-2	R 10 102 766	
C6-3	R 3 630 781	
C6-4	R 3 354 435	
C8-1	R 3 354 435	
C9-1	R 3 768 240	
C9-2	R 18 228 540	
C9-3	R 3 079 518	
E7-1	R 3 768 240	
E7-2	R 3 630 781	
E7-3	R 3 354 435	
E7-4	R 7 654 576	
E8-1	R 4 319 503	
E9-2	R 3 148 247	
G8-1	R 3 630 781	
G8-2	R 3 354 435	
TOTAL		**R 142 064 754**

Cost per capita = R 7 688

8.5.2.3 Indaka Local Municipality

Scheme Name	Cost	Total
New Borehole electronically operated		**R 14 662 014**
D10-2	R 3 079 518	
D10-3	R 3 632 211	
D10-4	R 4 319 503	
D11-1	R 3 630 781	
TOTAL		**R 14 662 014**

Cost per capita = R 6 676

8.5.2.4 Umtshezi Local Municipality

Scheme Name	Cost	Total
Small Package Plant		**R 97 471 795**
H11-4	R 97 471 795	
Existing boreholes electronically Operated with storage		**R 14 677 902**
I10-4	R 14 677 902	
New Borehole mechanically operated		**R 5 881 260**
I11-4	R 2 940 630	
J10-3	R 2 940 630	

New Borehole electronically operated		**R 149 607 968**
H8-4	R 4 320 933	
H11-2	R 4 663 149	
H11-3	R 3 839 828	
I8-1	R 4 458 391	
I8-2	R 6 322 658	
I8-3	R 4 182 045	
I8-6	R 3 907 128	
I9-1	R 3 630 781	
J8-1	R 3 562 052	
J8-2	R 3 424 594	
J8-4	R 3 010 789	
J8-5	R 5 487 900	
J9-1	R 2 231 578	
J9-2	R 2 984 741	
J9-3	R 1 541 427	
J10-1	R 3 218 406	
J10-2	R 3 564 911	
J10-4	R 3 838 399	
J11-1	R 4 252 204	
J11-2	R 5 562 348	
J11-3	R 3 355 865	
J11-4	R 3 149 677	
J11-5	R 3 287 135	
K8-1	R 3 493 323	
K8-2	R 3 424 594	
K8-3	R 3 355 865	
K9-1	R 5 698 377	
K9-2	R 3 079 518	
K9-3	R 3 630 781	
K9-4	R 4 250 774	
K9-5	R 3 355 865	
K9-6	R 7 211 849	
K9-7	R 3 079 518	
K9-8	R 4 455 532	
K9-9	R 3 079 518	
K10-1	R 3 905 698	
L8-1	R 3 355 865	
L8-2	R 3 216 976	
L8-3	R 3 216 976	
Existing boreholes electronically operated		**R 6 578 675**
J10-5	R 6 578 675	
TOTAL		**R 274 217 600**

Cost per capita = R 28 874

8.5.2.5 Imbabazane Local Municipality

Scheme Name	Cost	Total
New Borehole electronically operated		**R 15 786 415**
I7-1	R 3 493 323	
L7-1	R 3 354 435	
M7-1	R 8 938 657	
TOTAL		**R 15 786 415**

Cost per capita = R 5 532

Summary of long term supply

Municipality	Total Cost
Okhahlamba	R 572 510 006
Ladysmith / Emnambithi	R 142 064 754
Indaka	R 14 662 014
Umtshezi	R 274 217 600
Imbabazane	R 15 786 415
TOTAL	**R 1 019 240 789**

8.6 Phasing of scheme options

The phasing includes proposed plans to address the water backlogs. Various potential funding such as MIG, PIG etc. may be applied for to undertake these projects. The phasing is based on both the short and long term proposals.

An average cost for each scheme type was compared with the cost estimate for an individual scheme. If the scheme was less than or equal to the average it was assumed that the project could be untaken over a year. If the cost ratio was higher than the average cost, the ratio was used to determine the duration of the project. However, this is flexible depending on the nature and type of project.

An example of the above explanation is demonstrated as follows for the scheme type link to existing for the Okhahlamba Local Municipality.

Scheme Name	Cost
Link to existing	
F7-4	R 144 489 939
H2-1	R 265 678 519
H3-1	R 130 269 879
F2-7	R 9 317 837
F5-1	R 35 466 285
F5-2	R 24 345 126
F7-5	R 6 011 686
G2-1	R 93 058 191
G3-1	R 17 639 792
H4-5	R 24 167 640
H5-4	R 49 507 062
H6-2	R 65 806 008
I4-1	R 449 187 445
TOTAL	R 1 314 945 409

The total number of schemes is 13.

The total cost of the 15 schemes is R 1 314 945 409.

The average cost per scheme is R 1 314 945 409 / 13 = R 101 149 647.

To phase scheme G2-1 which costs R 93 058 191, is R 93 058 191/ R 101 149 647= 0.9, hence scheme G2-1 is phased to be undertaken in one year.

To phase scheme H2-1 which costs R 265 678 519, is R 265 678 519 / R 101 149 647= 2.6, hence scheme H2-1 is phased over three years.

The phasing of the schemes is indicated in Table 30.

Implementation Year	LM	Total Cost
2015/16	Okhahlamba	R 1 082 879 088
	Ladysmith / Emnambithi	R 427 798 709
	Indaka	R 917 775 383
	Umtshezi	R 446 788 044
	Imbabazane	R 250 450 365
		R 3 125 691 589

Implementation Year	LM	Total Cost
2016/17	Okhahlamba	R 41 038 203
	Ladysmith / Emnambithi	R 34 020 225
	Umtshezi	R 54 657 712
	Imbabazane	R 48 772 594
		R 178 488 735

Implementation Year	LM	Total Cost
2017/18	Okhahlamba	R 282 533 905
	Ladysmith / Emnambithi	R 18 228 540
	Umtshezi	R 155 156 726
		R 455 919 171

Implementation Year	LM	Total Cost
2018/19	Okhahlamba	R 481 004 219
	Ladysmith / Emnambithi	R 767 746 524
	Umtshezi	R 243 385 035
	Imbabazane	R 301 970 664
		R 1 794 106 441

Table 30 - Phasing of Schemes

9. DEVELOP AN UPDATED GEO DATABASE INCLUDING META DATA OF ALL RELEVANT INFORMATION

All the GIS infrastructure data, both existing and proposed, together with the water supply footprint areas have been incorporated into a structured geodatabase. All fields requested in the terms of reference, whether populated or not, have been included in the attribute tables of each dataset. Metadata for each dataset has been captured (for the entire dataset), and within the attribute table, metadata fields applicable to specific fields have also been included. These include metadata on the source of the population statistics, the water source data, and the connection type data.

A “completeness” field has also been included in the feature class for the water supply footprints. This field gives a snapshot view of the percentage completeness of all the fields in the dataset for each area.

Other data included in the geodatabase are administrative boundaries (wards, local municipalities, district municipalities) together with locality features such as place names and neighbouring countries. Both urban and cadastral data from the Surveyor General’s Office has been included. Social facilities including health facilities and schools have been provided, both to assist with water planning needs, as well as informing about the area in which the user is working.

All household information has been added to the geodatabase – Eskom household points as well as the DRDLR settlement boundaries. Topography in the form of 20m contours from the 1:50 000 topographic map series were used in the planning process, and can be found in the geodatabase. Rivers and road network data has also been included.

Along with all the base data, infrastructure specific to the District Municipality has been imported. The geodatabase also contains the data which has been captured during this project. The water supply footprints, proposed water pipelines and proposed water features (boreholes, standpipes etc.) have been added to the geodatabase. A detailed list of all the datasets, along with their metadata can be found in Annexure 1. An outline of the GIS methodology can be found in Annexure 2.

A detailed list of all the datasets, along with their metadata can be found in Annexure 1.
DVD’s containing all spatial information, along with files of all working maps, as well as the map series showing the planned service infrastructure, have been provided along with this report. A series of A0 maps have also been prepared and exported to pdf which can be viewed in Annexure 3. One map shows the entire district municipality, with others showing each of the local municipalities within the district.

10. CONCLUSION AND RECOMMENDATIONS

10.1 Total cost of proposed schemes in the Uthukela District Municipality

The following table gives an indication in the form of a summary of the proposed conceptual scheme types and the associated costs which need to be undertaken to alleviate the current water backlog of 96 113 households in the Uthukela District Municipality.

uThukela DM	
Scheme Type	
Link to existing scheme	R 4 534 965 147
Small Package Plants	R 316 799 185
Existing boreholes electronically operated	R 6 578 675
Existing boreholes electronically operated with Storage	R 79 515 407
New boreholes mechanically operated	R 23 525 040
New boreholes electronically operated	R 592 822 483
TOTAL	**R 5 554 205 937**

10.2 Total cost of phases of schemes in the Uthukela District Municipality

An average cost for each scheme type was compared with the cost estimate for an individual scheme. If the scheme was less than or equal to the average it was assumed that the project could be untaken over a year. If the cost ratio was higher than the average cost, the ratio was used to determine the duration of the project. However, this is flexible depending on the nature and type of project. A detailed description of the phasing can be viewed in section 8.6 of the report.

The proposed conceptual design schemes may be phased according to the tables below.

Implementation Year	LM	Total Cost
2015/16	Okhahlamba	R 1 082 879 088
	Ladysmith / Emnambithi	R 427 798 709
	Indaka	R 917 775 383
	Umtshezi	R 446 788 044
	Imbabazane	R 250 450 365
		R 3 125 691 589

Implementation Year	LM	Total Cost
2016/17	Okhahlamba	R 41 038 203
	Ladysmith / Emnambithi	R 34 020 225
	Umtshezi	R 54 657 712
	Imbabazane	R 48 772 594
		R 178 488 735

Implementation Year	LM	Total Cost
2017/18	Okhahlamba	R 282 533 905
	Ladysmith / Emnambithi	R 18 228 540
	Umtshezi	R 155 156 726
		R 455 919 171

Implementation Year	LM	Total Cost
2018/19	Okhahlamba	R 481 004 219
	Ladysmith / Emnambithi	R 767 746 524
	Umtshezi	R 243 385 035
	Imbabazane	R 301 970 664
		R 1 794 106 441

10.3 Proposed Future Work

It is recommended that the concept designs covered in this report be advanced to preliminary designs.

It is recommended that the link to existing schemes for the various local municipalities be undertaken first due to the existing water treatment and bulk infrastructure. The table below is a summary of the cost of the link to existing schemes that can be undertaken.

Link to existing schemes	
Local Municipality	**Total**
Okhahlamba	R 1 314 945 409
Ladysmith / Emnambithi	R 1 105 729 245
Indaka	R 903 113 369
Umtshezi	R 625 769 917
Imbabazane	R 585 407 208
Total	**R 4 534 965 147**

11. ANNEXURES

Annexure 1 - Database Design and attribute table

GEODATABASE STRUCTURE/DATA DICTIONARY			
BASE DATA			
FEATURE DATASET	**FEATURE CLASSES**	**DESCRIPTION**	**SOURCE**
Administration	District Municipalities 2011	District municipality boundaries from 2011	Demarcation Board
	Local Municipalities 2011	Local municipality boundaries from 2011	Demarcation Board
	Neighbouring Countries	Borders of neighbouring countries	SA Atlas
	Ocean	Dataset created to show ocean next to KZN coast	MHP GeoSpace
	Place Names	Main place names within KZN	SA Atlas
	RSA	Provincial boundaries	Demarcation Board
	Subplace Names	Subplace names from centroids of poylgon data	Statistics SA
	Wards 2011	Ward boundaries from 2011	Demarcation Board
Cadastral	Urban cadastral	Urban cadastral data	Surveyor General's Office, PMB
	Farm portions cadastral	Farm portion cadastral data	Surveyor General's Office, PMB
Facilities	Education facilities	Point dataset showing location of all schools	KZN Department of Education
	Health facilities	Point dataset showing location of all health facilities	KZN Department of Health
Hydrology	Major rivers	Major rivers within KwaZulu-Natal	Department of Water Affairs
	Minor rivers	Minor rivers within KwaZulu-Natal	Department of Water Affairs
Settlement	Households	2011 household points	Eskom
Topography	Contours 20m	Contours at 20m intervals	National Geospatial Information
Transport	DOT 2014	All roads (major and minor) from 2014	Department of Transport

INFRASTRUCTURE			
Infrastructure	Pumps	Point dataset showing existing pumps	Department of Water Affairs; District and Local Municipalities
	Supply Source	Point dataset showing existing water sources including boreholes and springs	Department of Water Affairs; District and Local Municipalities
	Waste Water Treatment Works	Point dataset showing existing waste water treatment works	Department of Water Affairs; District and Local Municipalities
	Water Meters	Point dataset showing existing water meters	Department of Water Affairs; District and Local Municipalities
	Water Pipelines	Line dataset showing existing water pipelines – bulk and reticulation	Department of Water Affairs; District and Local Municipalities
	Water Reservoirs	Point dataset showing existing reservoirs	Department of Water Affairs; District and Local Municipalities
	Water Treatment Works	Point dataset showing existing water treatment works	Department of Water Affairs; District and Local Municipalities
UAP			
UAP	UAP Demand Areas	Digitised water supply footprints around settlements in the District Municipalities within the project	MHP GeoSpace
	UAP Water Nodes	Digitised water nodes (boreholes, standpipes etc) captured off hard copy maps	MM PDNA/MHP GeoSpace
	UAP Water Lines	Digitised water pipelines captured off hard copy maps	MM PDNA/MHP GeoSpace

WATER SUPPLY FOOTPRINTS ATTRIBUTES

Field Name	Alias	Description	Units/Values/ Field Type
DM	District Municipality	Name of the municipality in which the area falls	Text
Area_m2	Area in square metres	GIS calculated	Number
Name	Name	Name of area if known	Text
Short_SS	Short term supply status	Is there an existing supply?	Y/N lookup table
Interim_SS	Interim supply status	Is there an interim supply?	Y/N lookup table
Bulk_SS	Bulk supply status	Is there a bulk supply?	Y/N lookup table
ST_Supply	Sustainable supply	Is the supply sustainable?	Y/N lookup table
Sust_2016	Sustainable to 2016	Is existing supply sustainable to 2016?	Y/N lookup table
Not_2016	Not sustainable to 2016	If N, What needs to be done to ensure sustainable supply to 2016?	Text
ExistPlans	Existing plans	Are there existing plans to ensure sustainably beyond 2016?	Y/N lookup table
Horizon30	30 year horizon plans	If Y, are these plans for 30 year horizon?	Y/N lookup table
Plans30yr	Detail of plans	If Y, what are these plans.	Text
Sust2046	Sustainable to 2046	If N, What needs to be done to ensure sustainable supply to 2046?	Text
Schm_E	Existing scheme name	Name of any existing supply scheme	Text
Schm_F	Future scheme name	Name of any future proposed scheme	Text
Sou_E	Existing source	Existing water source from lookup table	Lookup table (eg borehole, reservoir)
Sou_F	Future source	Future water source from lookup table	Lookup table (eg borehole, reservoir)
WatNam_E	Existing source name	Name of existing source	Text
WatNam_F	Future source name	Name of future source	Text

Proj_Typ	Project type	Type of project from lookup table	Lookup table (eg MWIG, BIG)
SuppDate	Scheme supply date	Date of proposed intervention	Text
Treat	Treatment type	Existing treatment type from lookup table	Lookup table (eg WTP, sand filter)
WTP_Nam	WTP name	Name of water treatment plant	Text
Conn	Connection	Type of water connection from lookup table	Lookup table (eg yard, house, community standpipe)
Design_E	Existing design demand	Demand for which this scheme has been designed	Number (million m^3 p.a.)
LowDemandForecast	Demand Low	Low demand forecast	Number (million m^3 p.a.)
HighDemandForecast	Demand High	High demand forecast	Number (million m^3 p.a.)
ProbableDemand	Probable demand	Probable demand forecast	Number (million m^3 p.a.)
Supp_E	Existing supply	Current water supply capacity	Number (million m^3 p.a.)
CurrentWaterRequirements	Water requirements	Current water requirements	Number (million m^3 p.a.)
FutureWaterRequirements	Future water requirements	Future water requirements	Number (million m^3 p.a.)
Proj_ID	Project ID	ID of project if known	Text
HH_Low	Households low	Lowest estimate of households served	Number
HH_High	Households high	Highest estimate of households served	Number
Pop_Low	Population low	Lowest estimate of number of people	Number
Pop_High	Population high	Highest estimate of number of people	Number
Capturer	Capturer	Person who captured the area from lookup table	Lookup table (eg MHP Geospace, Mlungisi Dimba MMPDNA)
Sanitation	Type of sanitation scheme	Type of sanitation scheme from lookup table	Lookup table (eg septic tank, VIP)
Comments	Comments	General comments	Text

Assumptions	Assumptions	Assumptions made about existing infrastructure	Lookup table (eg Existing water scheme has enough capacity to be extended)
Assumptions_Other	Other Assumptions	Any other assumptions made about the area	Text
PopStats_Source	Population Statistics Source	The data source for the population statistics	Lookup table (eg Census 2011, Eskom 2011)
Source_Metadata	Metadata on water source	Information on whether the population data has been edited or verified	Lookup table (eg. Spatial calculation, Verified)
Connection_Metadata	Metadata on connection type	Information on whether the population data has been edited or verified	Lookup table (eg. Spatial calculation, Verified)
Completeness	Completeness of data	A percentage showing the number of fields populated per rectod	Number
SettlementType	Settlement Type	Settlement type (rural, urban etc) where available	Text
SanitationLOS	Sanitation Level of Service	The current sanitation level of service where data is available	Text

WATER PIPELINE ATTRIBUTES

Field Name	Alias	Description
Pipeline_Type	Pipeline type	Type of pipeline from lookup table
Project_Type	Project type	Project type from lookup table
Supply_Type	Supply type	Supply type from lookup table
Water_Source	Water source	Water source from lookup table
Capturer	Capturer	Data capturer from lookup table
Comments	Comments	General comments

WATER NODE ATTRIBUTES

Field Name	Alias	Description
Node_Type	Type of facility	Type of facility from lookup table
Capturer	Data capturer	Data capturer from lookup table
Comments	Comments	General comments

LOOK UP TABLES

DOMAIN NAME AND CODES	DESCRIPTION
Capturer	**Name of data capturer**
0	Not updated
1	Juan Wood (MMPDNA)
2	Petrus Buthelezi (MMPDNA)
3	Mlungisi Dimba (MMPDNA)
4	MHP GeoSpace
5	District Municipality
6	MMPDNA Data Capturers
7	MMPDNA Team 2
Connection	**Water connection type**
0	Unknown
1	Yard connection
2	House connection
3	Community standpipe
4	Jojo tank
5	Reservoir
Metadata	**Metadata**
Calculated	Calculated
Verified	Verified
Captured	Captured by MHP GeoSpace
Quality Assured	QA by MHP GeoSpace

PopStats_Source	**Source of population stats**
Eskom	Eskom household points 2011
Census	Stats SA Census 2011
Project_Type	**Project Type**
0	Unknown
1	BIG
2	Umgeni Water
3	MWIG
4	Umhlathuze Water
5	CMIP
6	MIG 1
7	MIG 2
8	MIG 3
9	MIG 4
10	MIG 5
Sanitation_Type	**Type of Sanitation**
0	Unknown
1	VIP
2	Septic tank
3	Chemical
4	Waterborne
5	None
Treatment_Type	**Treatment Type**
0	Unknown
1	WTP
2	Chlorination
3	Sand filter
4	Package plant
5	None
Water_Source	**Water Source**
0	Unknown
1	Local water scheme
2	Borehole
3	Water tanker
4	Regional water scheme
5	Spring
6	Abstraction
7	Reservoir
8	Water Works
Yes_No	**Yes No**
0	Unknown
1	Yes
2	No

Assumptions	**Assumptions about water schemes**
Capacity can be extended	Existing water scheme has enough capacity to be extended
Scheme to be upgraded	Existing water scheme has to be upgraded in order to have capacity to extend
Supplied with electricity	The area is fully supplied with electricity
Functional boreholes	All existing boreholes are functional
Raw water sources have capacity	Raw water source has enough capacity to abstract from
Other	Other assumptions
Node_Type	**Type of water point captured**
0	Unknown
1	Reservoir
2	Pumpstation
3	Raw extraction
4	Water treament works
5	Waste water treatment works
6	Package plant
7	Borehole
Pipeline_Type	**Type of water pipeline captured**
1	Bulk
2	Reticulation
0	Unknown

Annexure 2 – GIS Methodology

GIS METHODOLOGY

WATER SUPPLY FOOTPRINTS

- Settlement data (DWA settlements; Department of Rural Development and Land Reform settlements; Eskom household points) overlaid on aerial photography
- Polygons digitized around settlement clusters with outlying households being incorporated where possible
- Polygons captured over whole district, including areas with existing supply
- Fields added to attribute table as per Umgeni Water requirements
- Web mapping application developed so polygons could be edited, updated, created by users outside of the office environment

POPULATION STATISTICS

- Census 2011 data extracted using the SuperCross application from StatsSA
- Household counts calculated for each polygon using a spatial join between the demand polygons and the Eskom 2011 household points
- Population growth rate calculated by extrapolating the growth rate for each ward from 2001 to 2014 using census data from 2001 and 2011
- Growth rate applied to the household count to obtain figures for the highest possible household number in 2014
- Total population was divided by the number of households per sub-place to get the average household size per house per sub-place
- Household size data linked to demand areas (spatial join) and summarized to get the number of people in each demand area
- Growth rate (as calculated previously) applied to these numbers to reach a best possible approximated population figure for 2014 per demand area
- Water demand forecasts (high and low) calculated by using these population figures multiplied by the estimated water consumption appropriate to each settlement type as advised by the engineers in accordance with the Department of water Affairs standard.

CURRENT WATER INFORMATION

- All available water data from the municipalities – boreholes, reservoirs, springs, pipelines, water treatment works etc – added to ArcGIS project along with the demand area polygons
- Demand areas selected according to data falling within their boundaries (select by location tool) and attribute table updated accordingly
- Where no data was available from the municipality, the spatial information from Umgeni Water and the Department of Water Affairs was used in this query
- Additional data was received towards the end of the project for Amajuba, Ugu and uThukela District Municipalities requiring the spatial queries to be rerun and the attribute tables updated accordingly

CONCEPT DESIGNS AND COSTING

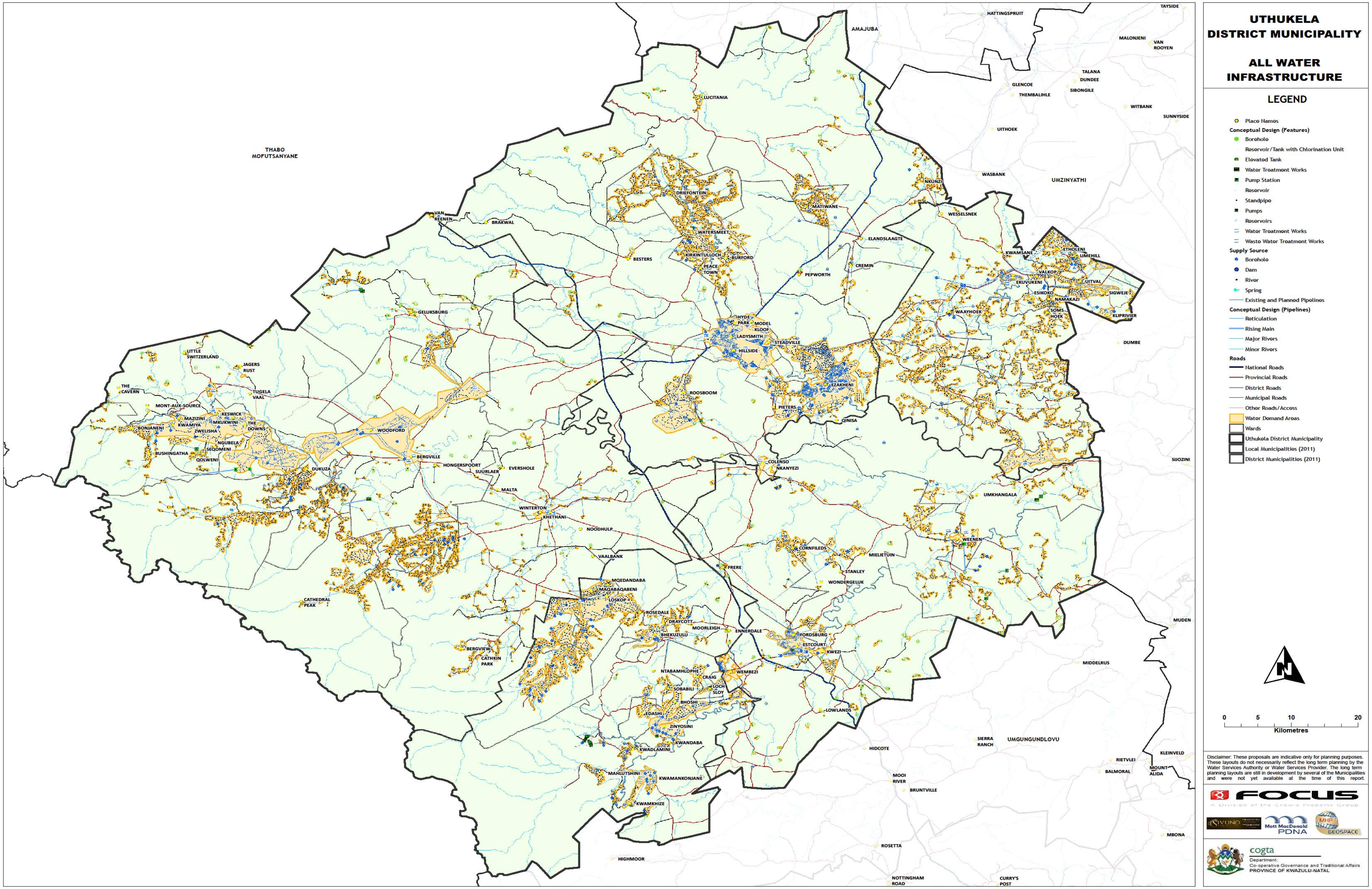
- All water infrastructure data and the water demand areas plotted on A1 maps at 1:20 000 scale
- Engineers produced concept designs hand drawn onto these maps
- Hard copy maps then scanned and georeferenced
- Concept designs digitized off the georeferenced scans

- Geodatabase with feature datasets for lines and points with available attribute information; domains used to reduce data capture time and possibility of errors
- Digitized data checked at map edges to ensure continuity of data
- All concept data (digitized) for each district merged to one dataset in the geodatabase
- Proposed water schemes given a unique ID by the engineers
- These ID captured into the GIS to link to the costing table from the engineers

METADATA

- Three geodatabases have been prepared:
    1. Base Data:
        - Roads, rivers, place names, administrative boundaries etc
        - Settlement data – Eskom household points
        - Cadastral data – urban and rural
        - Social facilities – health, education
        - Topography – 20m contours
    2. Infrastructure:
        - Existing pipelines, reservoirs, boreholes etc
    3. UAP:
        - Pipelines, standpipes, boreholes etc
        - Water supply footprints
- Metadata created for each dataset using ArcCatalog
- Data stored in WGS 1984

Annexure 3 – Planned Infrastructure Maps



UTHUKELA
DISTRICT MUNICIPALITY
ALL WATER
INFRASTRUCTURE
LEGEND
Place Names
Conceptual Design (Features)
Borehole
Reservoir/Tank with Chlorination Unit
Elevated Tank
Water Treatment Works
Pump Station
Reservoir
Standpipe
Pumps
Reservoirs
Water Treatment Works
Waste Water Treatment Works
Supply Source
Borehole
Dam
River
Spring
Existing and Planned Pipelines
Conceptual Design (Pipelines)
Reticulation
Rising Main
Major Rivers
Minor Rivers
Roads
National Roads
Provincial Roads
District Roads
Municipal Roads
Other Roads/Access
Water Demand Areas
Wards
Uthukela District Municipality
Local Municipalities (2011)
District Municipalities (2011)
0 5 10 20
Kilometres
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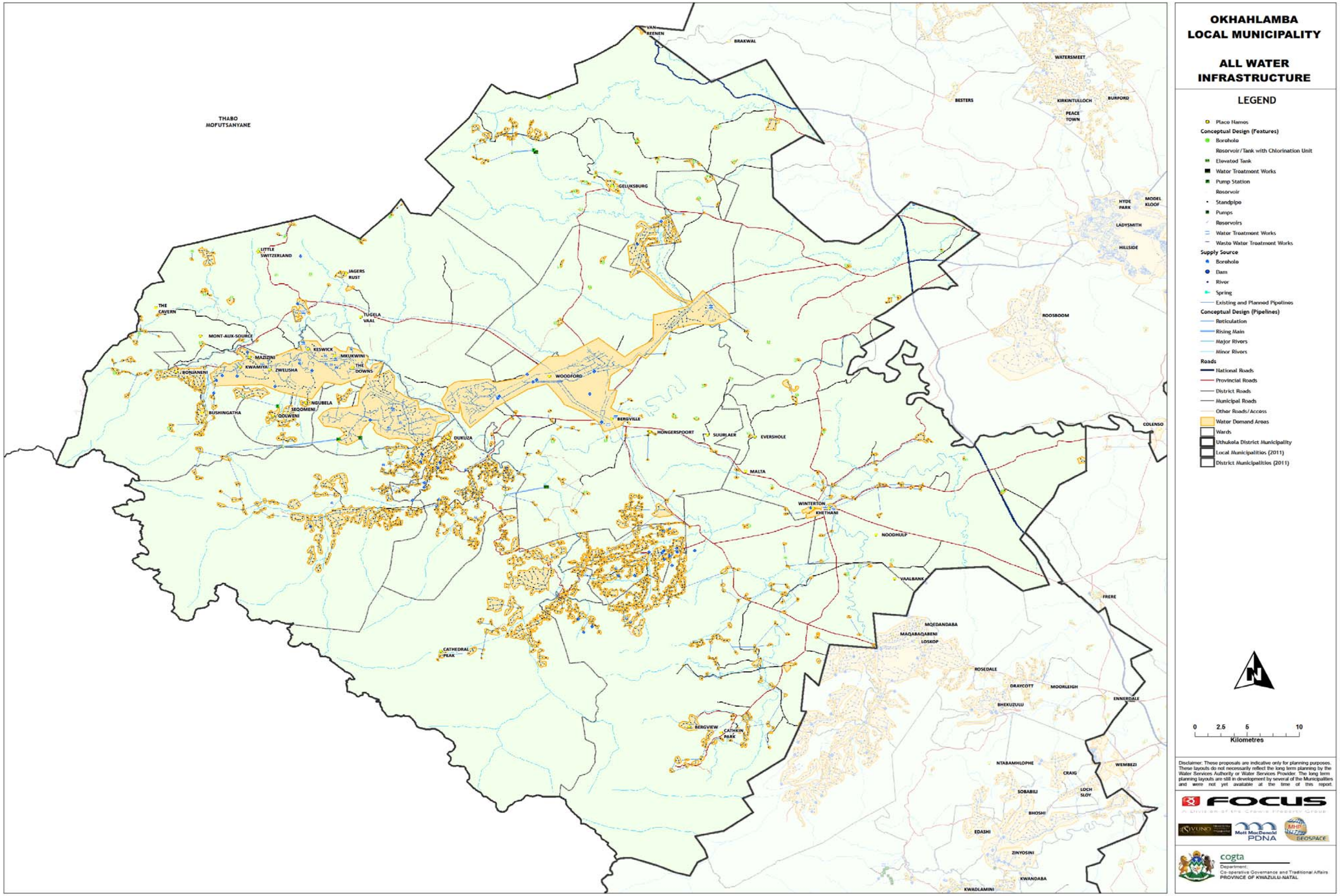
THABO MOFUTSANYANE
AMAJUBA
UMZINYATHI
UMGUNGUNDLOVU
LADYSMITH
WOODFORD
BERGVILLE
WINTERTON
COLENSO
ESTCOURT
WEENEN


OKHAHLAMBA
LOCAL MUNICIPALITY
ALL WATER
INFRASTRUCTURE
LEGEND
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0 2.5 5 10
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FOCUS
Mott MacDonald PDNA
MHP GEOSPACE
cogta
Department: Co-operative Governance and Traditional Affairs PROVINCE OF KWAZULU-NATAL
THABO MOFUTSANYANE
VAN REENEN
BRAKWAL
WATERSMEET
BESTERS
KIRKINTULLOCH
BURFORD
PEACE TOWN
GELUKSBURG
HYDE PARK
MODEL KLOOF
LADYSMITH
HILLSIDE
LITTLE SWITZERLAND
JAGERS RUST
THE CAVERN
TUGELA VAAL
ROOSBOOM
MONT-AUX-SOURCE
KESWICK
MKUKWINI
THE DOWNS
MAZIZINI
KWAMIYA
ZWELISHA
BONJANENI
WOODFORD
NGUBELA
SEQOMENI
QOLWENI
BUSHINGATHA
BERGVILLE
HONGERSPOORT
SUURLAER
EVERSHOLE
DUKUZA
COLENSO
MALTA
WINTERTON
KHETHANI
NOODHULP
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FRERE
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MAQABAQABENI
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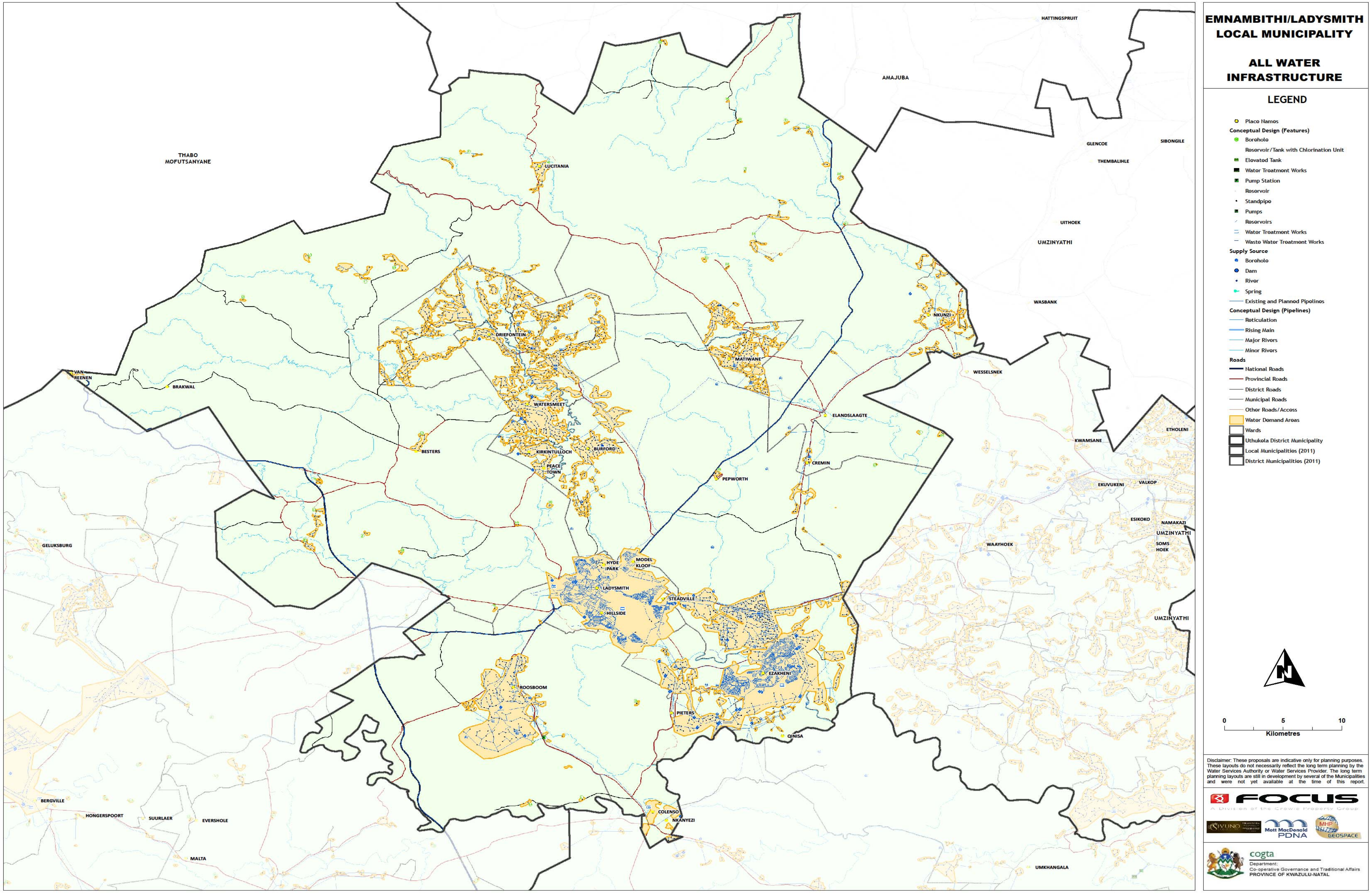
EMNAMBITHI/LADYSMITH LOCAL MUNICIPALITY
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GEOSPACE
cogta
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LUCITANIA
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UMZINYATHI
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QINISA
BERGVILLE
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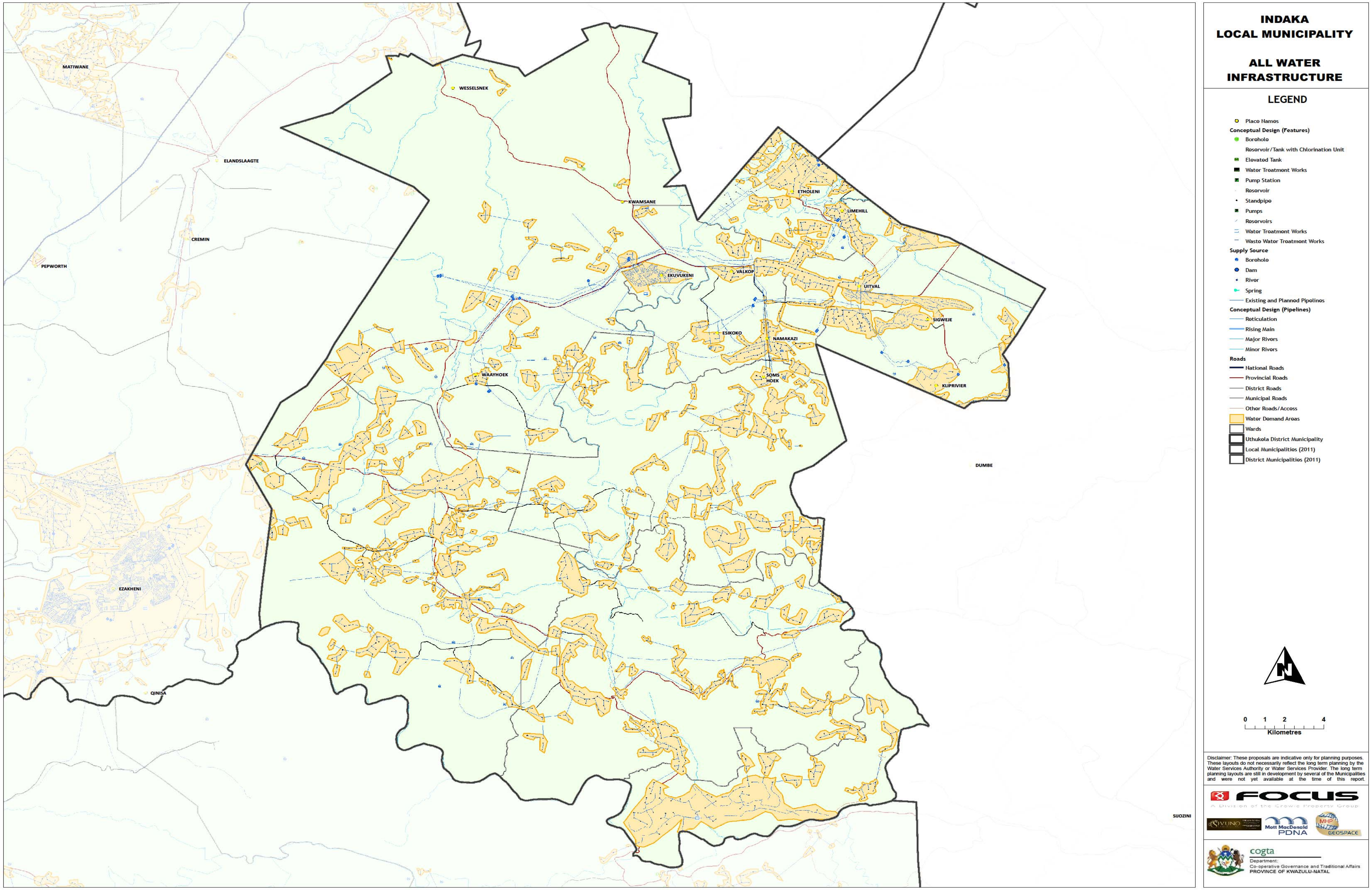
SUURLAER
EVERSHOLE
COLENSO
NKANYEZI
MALTA
UMKHANGALA



INDAKA
LOCAL MUNICIPALITY
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cogta
Department:
Co-operative Governance and Traditional Affairs
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WESSELSNEK
ELANDSLAAGTE
KWAMSANE
ETHOLENI
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CREMIN
PEPWORTH
EKUVUKENI
VALKOP
UITVAL
SIGWEJE
ESIKOKO
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SOMS
HOEK
KLIPRIVIER
WAAYHOEK
DUMBE
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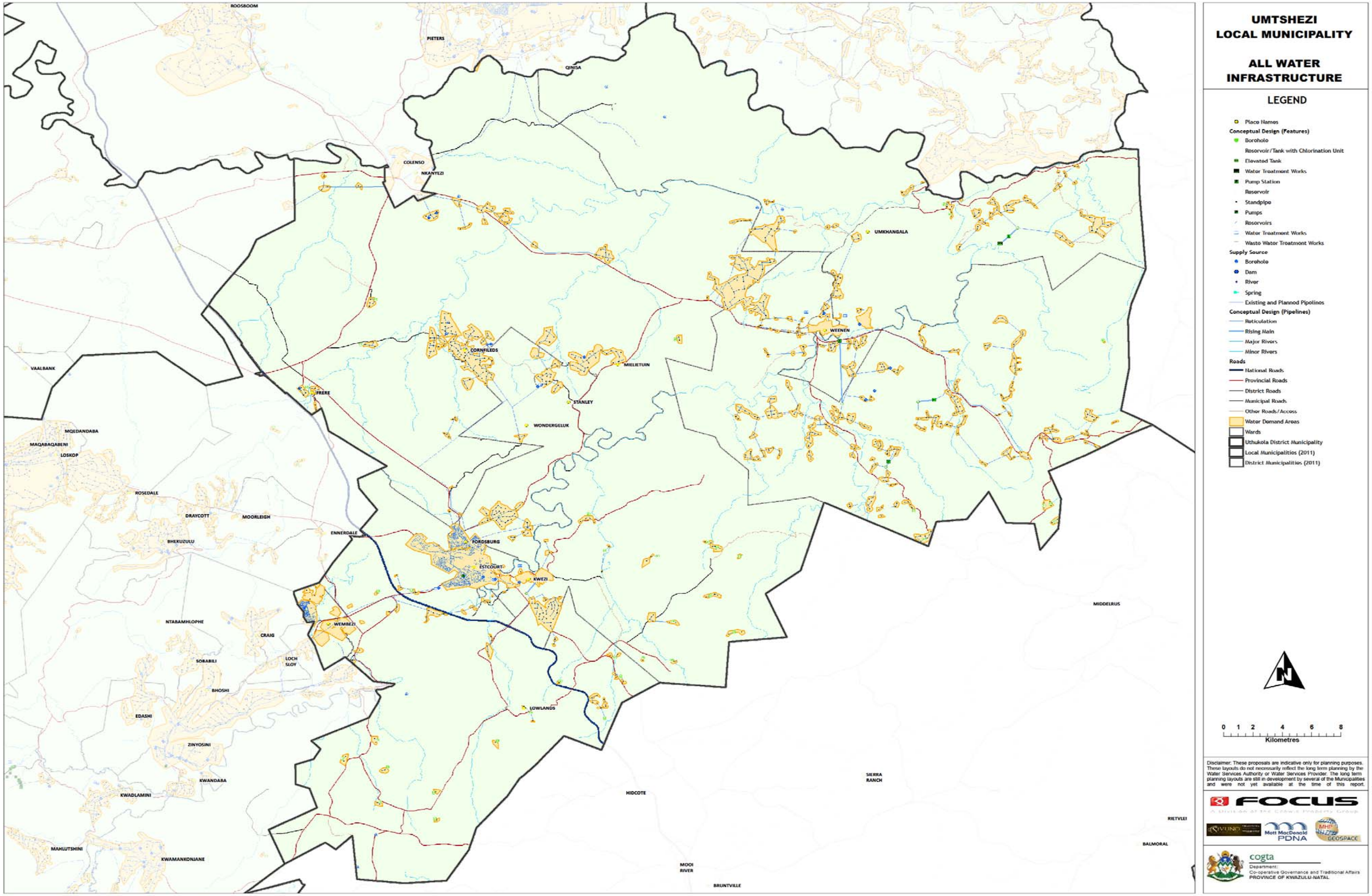
QINISA
SIJOZINI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KWADLAMINI
MAHLUTSHINI
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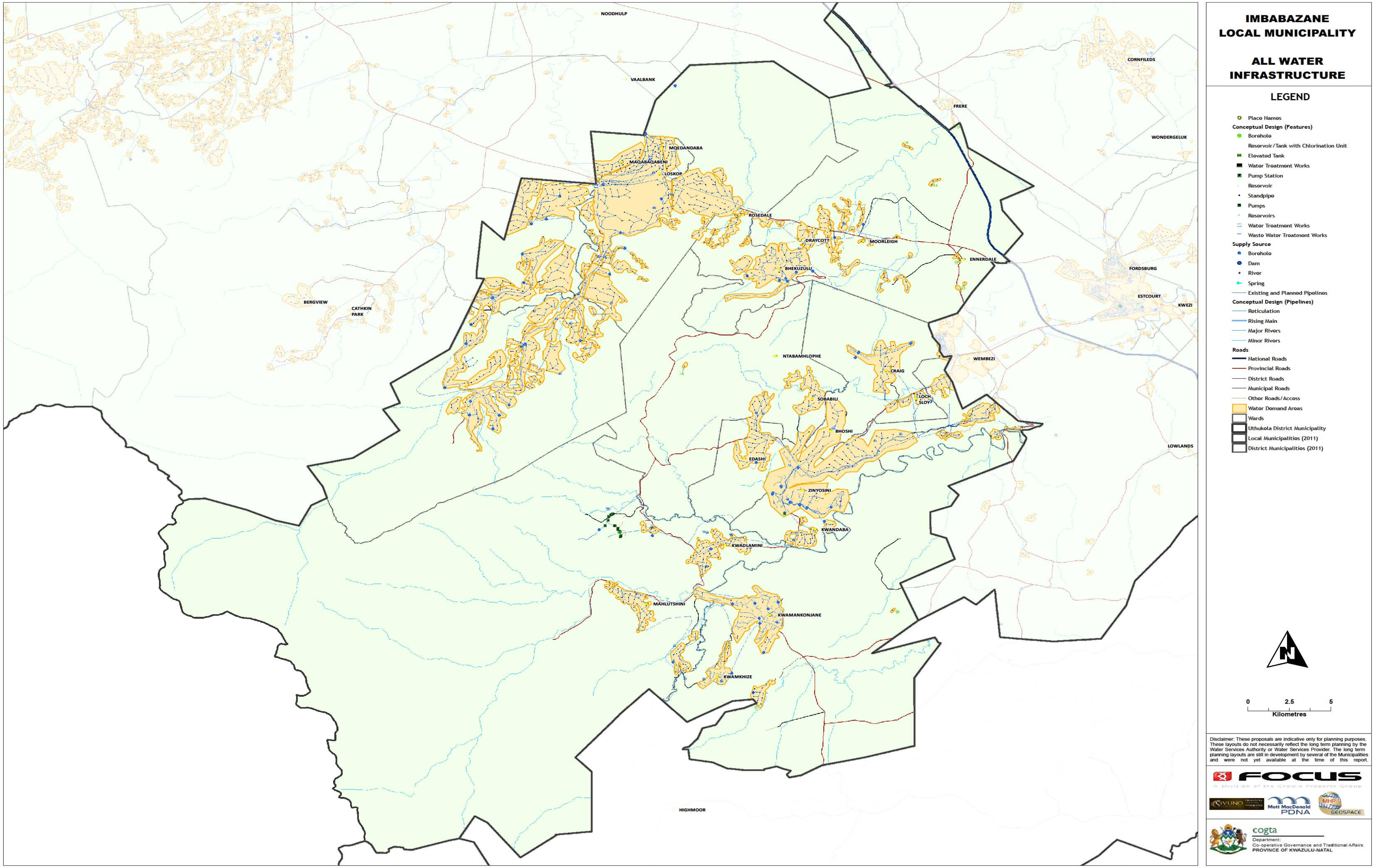
HIDCOTE
RIETVLEI
BALMORAL
MOOI RIVER
BRUNTVILLE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DRAYCOTT
MOORLEIGH
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BHEKUZULU
FORDSBURG
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KWEZI
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PARK
NTABAMHLOPHE
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SLOY
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ZINYOSINI
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KWADLAMINI
MAHLUTSHINI
KWAMANKONJANE
KWAMKHIZE
HIGHMOOR
cogta
Department:
Co-operative Governance and Traditional Affairs
PROVINCE OF KWAZULU-NATAL

12. ACKNOWLEDGEMENT AND DISCLAIMER

This report was prepared by the consortium consisting of Focus, Mott Macdonald PDNA, MHP GeoSpace and Sivuno Consulting with the technical support from Uthukela District Municipality under the direction and review from COGTA and Umgeni Water.

The information and data obtained in this report was obtained from Uthukela District Municipality Infrastructure Development Plans (IDP's), Water Services Development Plans (WSDP) and mainly engagements with Uthukela District Municipality staff.

Neither the consortium nor any of its employees assume any liability or responsibility for any third party use of any information discussed in this report.

The primary contact regarding questions or comments on this document is:

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Email address: muziwesipho.ngwane@misa.gov.za